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## Industry's No. 1 Job

NO ONE needs to be reminded that dangerous political forces are at work in this country. Demagogues have triumphed in many primary elections through bizarre methods of spreading misinformation about industry and technology. Too often these charges have gone unanswered because business executives and technical men who know the facts have been unwilling or unable to present them in a way that can be understood by the general public. The job has been left to the opposing politician with the sorry result that the hoped-for return to sanity in relations between government and industry is pushed farther and farther into the future. And the time is fast approaching when some of our industries are going to have to fight for their very existence.

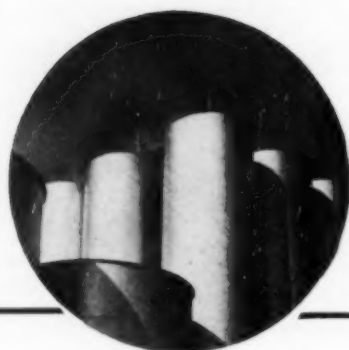
In certain sections of the country, public ownership of the electrical utilities is threatening to spread to other fields of industry. Federal control of huge sources of hydroelectric power has sometimes broken down state and local autonomy so that the communities most affected have little or nothing to say about their own rights. Labor dictatorships in several cities are throttling the shipping business and with it many industries that depend upon outside markets. Taxes are highest on record—actually confiscatory in some of these same cities. The federal legislation on wages and hours is being made more rigid and therefore more dangerous through ill-conceived enactments by state legislatures or through local misunderstanding and faulty interpretation.

Most of these problems have been recognized and are being discussed by chambers of commerce, trade associations, and other industrial groups. Strong editorials have appeared in the business and technical journals, and yet it is unfortunately true that these discussions have mostly reached the ears

of those who are already of the same beliefs and creeds. The vital need today is for an active program of public education that will penetrate further into the ranks of the people whose votes are electing the demagogues and scheming politicians.

Paul W. Garrett of General Motors is one who has given a great deal of thought to this problem of public relations. He has said, "If the American business system is to preserve the right to continue its contributions to the general welfare, it must learn to interpret itself in deeds and in words that have meaning to others than itself." He would have that educational program begin at home with the immediate family of employees in the plant and office. Then and then only can it spread to the "hometown folks" in the plant community and, finally, through the company's business contacts, to its customers and the ultimate consumers of its products. He contends that all this will not be difficult "once industry sets about its public relations with the same serious effort that in eras gone by it set about its financing, engineering and production problems."

"Facts and Figures of the American Chemical Industry," compiled a year ago by *Chem. & Met.* may prove a helpful source for some of the information that is needed for a better program of public relations and education in your company and community. Beginning in October, this and other McGraw-Hill magazines will initiate additional editorial services to aid the various industries in assembling the basic facts and interpreting their significance. In the meantime, aggressive action must continue on many fronts. Engineers as well as executives, must accept their full share in the responsibility for what Mr. Garrett has called "Industry's No. 1 Job."



## From an

### DIXIE LOSES A BENEFACTOR

DR. CHARLES H. HERTY passed away near the end of July at his home in Georgia. His long and useful life had been full of accomplishments and honors of national significance, but he will be remembered best as a great Southern scientist and benefactor because his most valuable achievements were *in* the South and *for* the South. It was fitting that his final effort proved to be the outstanding one of his career. He had devoted his last few years to the project of tapping the forest resources of the South and converting them into white paper that would not only bring vast wealth to the section but would make America independent of foreign sources of supply. Fortunately, he lived to see his effort crowned with even greater success than he had foreseen.

### MANAGEMENT ON THE SPOT

THE AMERICAN BUSINESS EXECUTIVE is on the spot as never before in the history of the country. Workers are raising a storm of protest over their share of the profits. Reduced dividends have aroused stockholders to criticize the compensation of management and its dealings with employees and government. Consumers are discontented with the pricing, sales, and other policies of industry. And federal officials are openly hostile to the manner in which economic and social responsibilities are handled by management.

These powerful forces have led other countries to controlled direction of industry and are rapidly leading our own in the same direction. If the system of free enterprise is to be maintained in America every ounce of skill, resourcefulness, and energy management can muster will be required to stem the tide and restore industrial harmony.

The Seventh International Management Congress at Washington, D. C., in September, will give executives an opportunity for interchange of experience and for regaining the approval and confidence of workers, stockholders, consumers, and government in management. This triennial meeting of world leaders and experts in the field of management of business, industry, commerce, agriculture, and the home, is to be held under the auspices of the International Committee of Scientific Management of which the Right Honorable the Viscount Leverhulme of Great Britain is president.

### INDUSTRIAL RELATIONS—1938 MODEL

RECENTLY in walking through a large petroleum refinery with its general superintendent, we were impressed with the cordiality with which this technically trained executive was greeted by the hundreds of employees whom we met. For each he had a personal word or question, infallibly calling the man by a familiar name or nickname. Finally our curiosity got the best of us and we asked if there were any of the company's 2,000 employees that he did not know or could not call by name. He admitted that perhaps there were a few but said that for the past year he had made it his first job to get intimately acquainted with all of his fellow workers.

"After all," he said, "in these days our company is pretty much of a philanthropic organization—at least that's the way our state and federal governments seem to regard us. We're just an agency to pay taxes and otherwise contribute to the distribution of wealth through the socialization of industry. Our stockholders don't seem to enter into the picture so I'm trying to do what I can to see that our employees get their full share and are happy and contented with their lot."

All this seemed a far cry from our friend's chemical engineering training and experience. Yet it was most evident that in developing these essentially human characteristics he had broadened his own perspective and better fitted himself for executive responsibility in his company. He had become a leader to whom wholehearted loyalty and respect were cheerfully given. In these trying times there would probably be less unrest among labor and more long-time benefits to stockholders if some of this same philosophy of management guided all of our industrial relations.

### M.E.'S LOSS, ENGINEERING'S GAIN

ONE OF OUR IMPORTANT educational institutions recently sought a chemical engineer to head its department of mechanical engineering. This brash heresy on the part of the dean of engineering—himself a chemical engineer—came in for heated discussion among educators who attended the Texas meeting of S. P. E. E. Most of them seemed to feel that it was a bit cruel thus to rub salt into the wounds of the older brother in the engineering pro-

# Editorial Viewpoint

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fession. Yet we found a few mechanical engineers who were willing to admit that there was a little logic in the arguments of the dean.

He contended that mechanical engineering—at least in his own institution—had fallen into a rut. The course was wedded to a lot of outmoded ideas, centering around a huge investment in a laboratory of mechanical equipment equally far out of date. There had been little or no research to stimulate new thinking. The rapidly growing chemical engineering department had stolen the lead in its courses in thermodynamics, heat transfer and other subjects that once were essentially the property of the mechanical engineer. Therefore, this dean argued that by bringing in a qualified chemical engineer he might develop interest in research that would help his department win back some of its lost prestige.

In the last analysis, of course, much of what we now call chemical engineering was once regarded as mechanical engineering. Most of the unit operations are mechanical—or at least, applied physics. The reason they were taken over by the chemical engineer was primarily the need for more fundamental, quantitative information that would help in applying these physical operations in chemical processes. Purely empirical knowledge would not suffice, hence research was necessary and often developed new data of tremendous importance in the design and construction of chemical engineering equipment. If in this process mechanical engineering lost anything in the way of prestige, chemical engineering was not the sole gainer. The benefits were passed on to the process industries in the form of new technology, shared by both chemical and mechanical engineers.

## TEXTILE FUNDAMENTALS

RESEARCH ON TEXTILES has been materially stimulated by the grants from the Institute for Textile Research. This year the bulk of the work so aided is being done at the National Bureau of Standards. This concentration of projects at one institution will, it is hoped, augment the useful results which can be obtained as in contrast with scattered studies at a variety of educational and independent institutions.

With its increased authority, the Bureau has

wisely reconsidered the whole problem of textile research and has decided that fundamental investigations, rather than those of practical significance shall be pressed.

Many steps in the manufacture of textiles are still sometimes guided by rule-of-thumb procedure. Numerous materials used in preparing, treating, finishing, or dyeing textiles are used with the guidance of art rather than science. Therefore manufacturers of textile chemicals will follow with interest the results of fundamental investigations from whatever source they may be had. In fact the pressure of materials makers in the textile industry should more and more be in the direction of encouraging, if not actually demanding, a scientific basis for operations. The results will be beneficial and profitable both to producers and users of the chemicals.

## EXPORTING BRAINS

WHEN DR. VLADIMIR ZWORYKIN, director of electronic research for R.C.A., received his honorary doctor's degree from the Polytechnic Institute of Brooklyn, his great friend and employer, David Sarnoff, was constrained to comment on the irony in certain international patent negotiations. It seems that Zworykin did not get along any too well in his native Russia, even though he had already demonstrated his brilliant talents for research. He came to this country an exile but he found here an opportunity to develop his concepts of television that are universally recognized as the basic foundation of that rapidly expanding science.

Recently it was Mr. Sarnoff's privilege to complete negotiations with the U.S.S.R. government for licensing certain of the Zworykin patents on television. Thus the royalty-hating Russians are to pay royalty on the products of a mighty brain they saw fit to exile. Perhaps there is a thought in this for other countries that in their nationalistic fanaticism are exporting some of their best brains in science, medicine, and philosophy. There might even be a germ of an idea in this story for industrial executives who in times of stress see fit to release valuable research workers and engineers. It hurts to have to pay royalties to a competitor—especially if the process happens to have been developed by a former employee.



# Cellulose Acetate by Hercules

*The closed system of processing is one of the features of the process that is unique in this country. The methylene chloride solvent contributes materially to the uniformity of the finished product and effects a saving in cost.*

THE ENTRANCE of Hercules Powder Co. into the manufacture of cellulose acetate on a large-volume basis is an excellent example of the manner in which a sound and progressive company can develop its position in the chemical industry. Hercules, with an unexcelled background of cellulose chemistry, derived from large scale production of pure cellulose and cellulose compounds (notably, nitrocellulose), entered the allied cellulose acetate field only after completing extensive market surveys, process investigations, and semi-plant operation, extending over a period of years.

The introduction of a material, even one closely related to existing products of the company, called for a complete understanding of the chemical engineering involved, plus sales analy-

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ses, and, most important of all, an appreciation of the requirements of consumers for a product of highest possible quality.

When market surveys indicated that cellulose acetate for molding and other purposes was destined to have a brilliant future, Hercules laid its plans to enter the field. Extensive research investigations, centering at the company's modern experiment station at Wilmington, Del., led to the investigation of processes, used in this and in foreign countries.

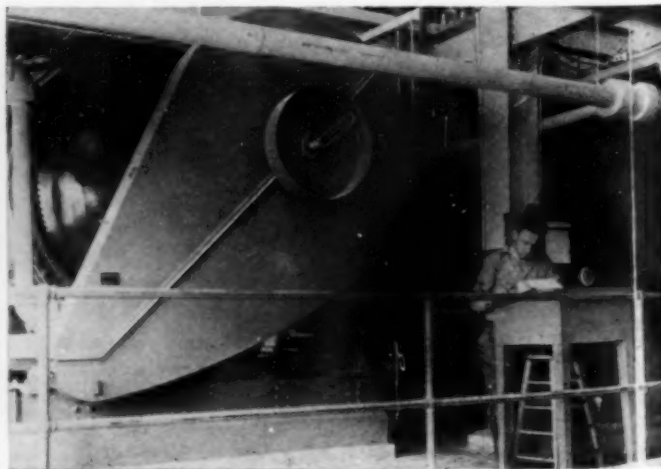
To follow the course of introduction of a material, it is of interest to note that, after all methods of production were studied, a semi-plant

unit was erected near the company's nitrocellulose plant at Parlin, N. J. This plant was in operation for some time, when continued research indicated that cellulose of the highest possible quality could be obtained by using the process held by I. G. Farbenindustrie. Accordingly, arrangements were made to use this process with certain modifications of Hercules' own.

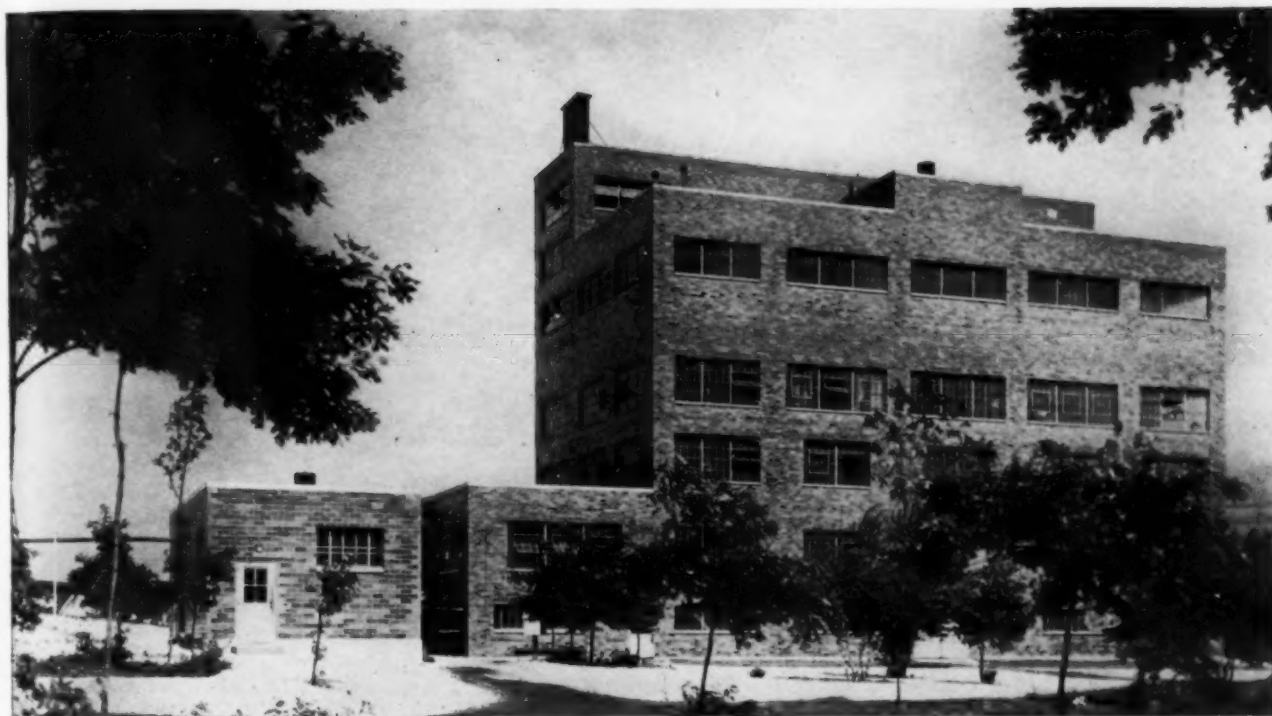
Extensive cooperative research and semi-plant work was done by the two organizations. During this period and later, while the plant was under construction, many trips were made across the ocean by engineering representatives of both companies. Some of the American engineers stayed in Europe for months at a time, studying the processing; likewise, I. G. representatives remained on the job in this

Materials of construction are an important factor in this modern plant. All blow lines and cyclones for acetic acid handling up to the acetylators are of aluminum construction

When pretreatment is completed, the mix is transferred through a conduit into the huge acetylators—probably the largest in the world. In this reaction, acetic acid, acetic anhydride, methylene chloride, and a catalyst are used







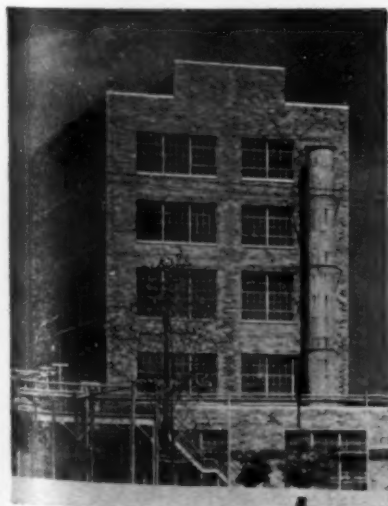
*Photographs by Richard Carver Wood*

The Hercules plant at Parlin, N. J., bold in conception and of sturdy construction. Of glazed tile, inside and outside, its architecture expresses a modern feeling in keeping with this modern chemical plant

country until production was started.

When semi-plant operations established the quality of Hercules cellulose acetate, plans were made to erect the commercial plant at Parlin, where the company owned considerable acreage. The actual site of the acetate plant was located in an isolated position, several hundred yards from the nearest structures of the

The acetic acid recovery building, like the main building above, is an example of good construction



other departments of the plant. Isolation was preferred as an aid in keeping the product free from dirt and other foreign matter. Safety, and possible expansion of production facilities, were other considerations in selecting the site.

Construction work on the first two units was started in July, 1936. Operations commenced a year later, and shortly proved so successful that it was necessary to arrange for increased production. Thus, when the plant was visited a month ago, construction was being started on the third and fourth units. It will be necessary to enlarge buildings and equipment for recovery, storage, and processing. The present capacity of the plant is 2,400,000 lb. annually, while the two additional units will bring the capacity up to 5,000,000 lb.

To obtain a quality product, efficient operation, and flexibility to permit the production of widely differing grades of cellulose acetate with minimum delay, required a plant different from any in operation in this country. The Hercules plant, bold in conception and of sturdy construction, projects six stories high out of the surrounding hills. Of glazed tile, inside and outside, its architecture expresses a modern feeling in keeping with this modern chemical plant. Supported

by a heavy steel frame, and utilizing steel sash and concrete floors, the building is an excellent example of good construction.

Numerous windows provide adequate light and ventilation. The glazed tile promotes cleanliness inasmuch as dusting and washing are made easier. The Robertson Protected Metal which served as forms for the concrete floor also has the advantage of eliminating spalling of concrete in corrosive atmospheres. On top of the concrete both acid-proof tile and mastic flooring are used. All exposed interior steelwork is coated with a corrosion-resisting chlorinated rubber paint, although there is seldom any acetic acid vapor in the plant.

Materials of construction are an important factor in this modern plant. All blow lines and cyclones for acetic acid handling up to the acetylator are of aluminum construction. Acetylators and hydrolyzers are made of a special bronze alloy. Tanks, pipe lines, pumps, condensers, and other equipment used in handling methylene chloride are stainless steel (KASMo). Compressed air lines and water lines used throughout the entire plant are copper with soldered joints to prevent contamination.

Special water filters supply ample water for processing; steam and com-

pressed air are piped from a power house about a quarter of a mile away. Overhead blower radiators provide a uniform temperature throughout the building even on the coldest days. This not only contributes to the uniformity of the cellulose acetate, but also insures against dust accumulations.

#### Cellulose Acetate Plant

The cellulose acetate plant consists of the process building, the acetic acid recovery system, and the raw and finished storage. The flow of materials in process is unique in cellulose acetate plants inasmuch as a gravity scheme is used. By this method, (1) the raw materials are carried to the top of the building; (2) pass downward to acetylation and hydrolysis; (3) after treating, are carried to the top of the building again for final passage through the dewatering and drying equipment. This minimizes handling and permits use of closed lines between units.

The sturdy construction and elaborate detail designed to protect the product is further carried out in the

actual process equipment itself. Made on a batch process, the product is free of dirt, impurities and fibers because of the completely enclosed system of process vessels and conveyors.

The closed system of processing is one of several features of the process that makes it unique in this country. Numerous sight glasses permit the operator ready observation of what goes on in the pipe lines, reaction vessels, and other pieces of equipment.

Actual processing begins when cotton linters, baled and carefully wrapped in heavy kraft paper at the company's own purification plant at Hopewell, Va., are removed from the adjacent storage building and elevated to the top of the processing building. There, the wrapper is removed and the bale is put into the picker.

This loosens the compressed fibers, which are then carried in an enclosed conveyor to a pretreating vessel, in which the fibers are activated for reaction.

When pretreatment is completed, the mix (a wet mass) is transferred

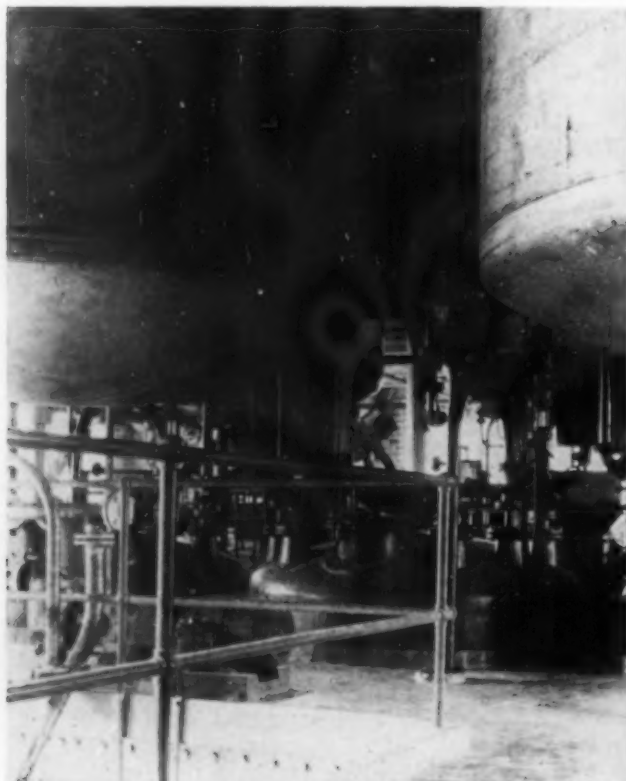
through a conduit into the huge acetylator—probably the largest in use in the world for acetylation. In this reaction, acetic acid, acetic anhydride, methylene chloride, and a catalyst are used. These chemicals are pumped to the top of the building and are measured in a mixing tank before being run into the acetylator.

Uniformity of product is assured by the large batches of finished product made in each unit. This step, taking several hours, is carefully controlled as to temperature, since during the period the fibers of cotton linters become acetylated and dispersed in the excess acid to give a thick paste.

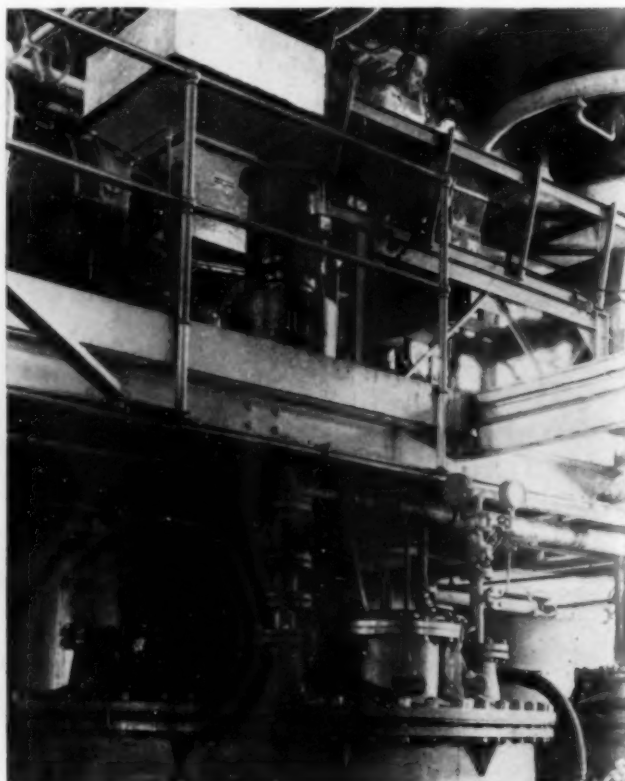
#### Methylene Chloride Used

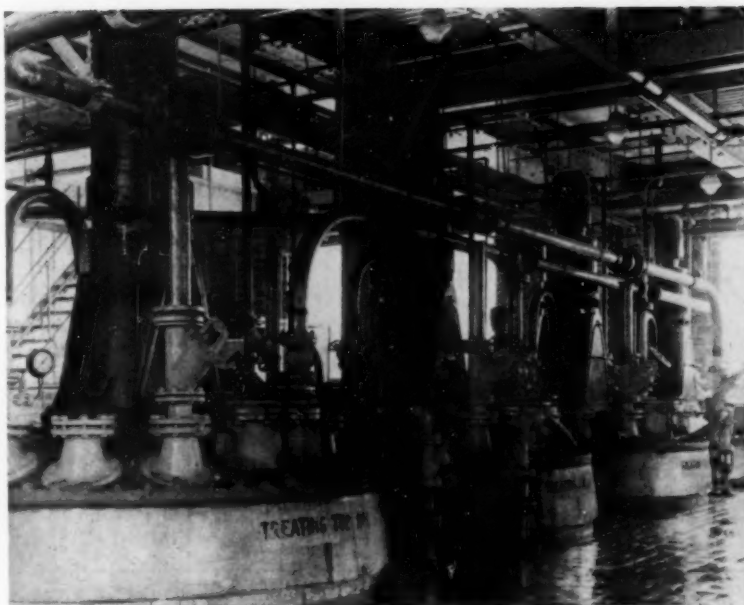
Methylene chloride is one of the best solvents for cellulose acetate. Its presence insures an extremely smooth and homogenous solution during the course of the reaction, which contributes materially to the uniformity of the finished product. The solvent also has a low boiling point and this property helps in the close control of temperature during acety-

Treating tubs in upper foreground, hydrolyzers in upper rear with operator inspecting the cellulose acetate on the vibrating screen. The acetic acid storage tanks are below

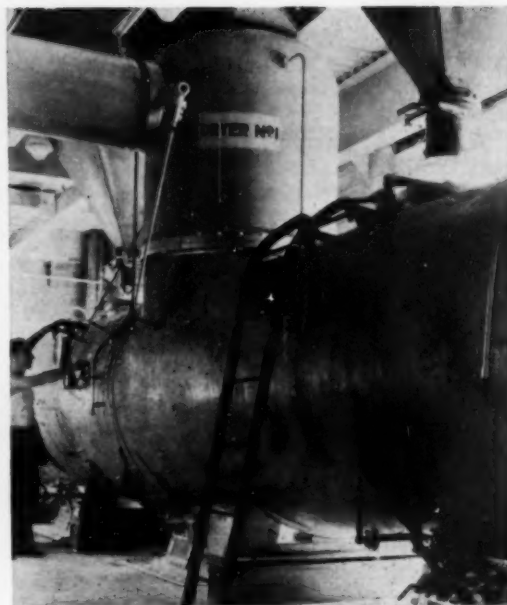


Hydrolyzers and stainless steel receiving tubs. At the Hercules plant, hydrolysis is relatively rapid, lasting only a few hours, thereby greatly shortening the manufacturing cycle





Treating tanks where the purification and washing are done, showing the closed pipe lines through which the ester in water suspension is conveyed to drain bins at the top of the processing building, from which it is fed into the driers



One of two driers made of stainless steel and aluminum. These driers reduce the water content to less than 0.5 per cent, and at the same time preserve the excellent properties

lation. It likewise effects a saving in cost since it replaces part of the acetic acid formerly used as solvent. The concentration of acetic acid is quite complicated whereas methylene chloride is separated from water by simple decantation. The loss of solvent is almost negligible.

When the solution becomes free of fibers and tests indicate uniform acetylation and proper viscosity, it is transferred to the hydrolyzer for proper hydrolyzing. This operation results in the preparation of correct acetic acid content to conform with type requirements.

#### Hydrolyzing

This is accomplished by adding predetermined amounts of water to the mix and holding it at a controlled temperature. The hydrolysis is regulated by rapid and sensitive tests which enable the operator to determine the degree of acetylation of the charge. At the proper time, the acid catalyst is "killed" by neutralizing it, and the charge precipitated in a large excess of water. At the Hercules plant, hydrolysis is relatively rapid, lasting only a few hours, thereby greatly shortening the manufacturing cycle.

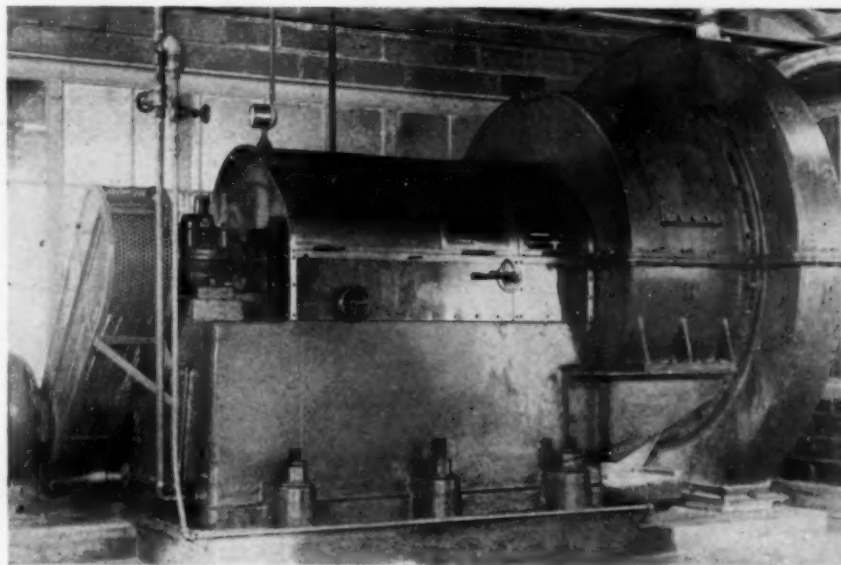
The precipitated ester is sent through closed lines to large tubs where stabilization is effected. At

this point the material has passed to the ground floor of the building. The stable ester is next conveyed in enclosed lines to drain bins at the top of the building, from which it is fed into large cylindrical driers which reduce the water content to less than 0.5 per cent, and at the same time

preserve the excellent color, clarity, and stability of the product.

Of particular interest is the Baker Perkins-ter Meer stainless steel continuous centrifugal for dewatering prior to drying. It has a perforated basket mounted on a horizontal shaft operating at 850 r.p.m. Slurry is

Stainless steel continuous centrifugal for dewatering prior to drying, has a perforated basket mounted on a shaft operating at 850 r.p.m. Slurry is charged into the small end of an inlet. The material finally falls out of the open end of the drum at a moisture content of 60 per cent





charged into the small end of an inlet which spins at the same speed as the main drum. In its passage through the funnel the motion of the material is gradually accelerated to the full drum speed. It passes into the drum through an annular space between the back face of the funnel and the front face of a pusher, which forms the back wall of the drum. This piston not only spins at the same speed as the drum but also has a reciprocal horizontal motion. Thus the material is continuously forming a cake on the drum wall building up to a depth of 2 in. and being shoved along the wall while dewatering. It finally falls out of the open end of the drum at a moisture content of 60 per cent into a dry material housing, dropping into the feed bins above the driers.

The rear and one side of the centrifugal are shown in an accompanying illustration on page 407. Additional information about this type of machine may be found on page 435.

As all the equipment is made of corrosion-resisting seamless metal and is enclosed, there is little chance of contamination by tramp fibers, dirt, or splinters. The dry ester, of uniform particle size, is packed into waterproof containers for shipment.

#### Acetic Acid Recovery

A byproduct of the manufacture is weak acetic acid of 18-20 per cent strength. While the use of methylene chloride reduces the amount of weak acetic, nevertheless the recovery is important. The recovery is made as glacial acetic acid in a separate building by a counter-current cold extraction process, which is efficient and economical.

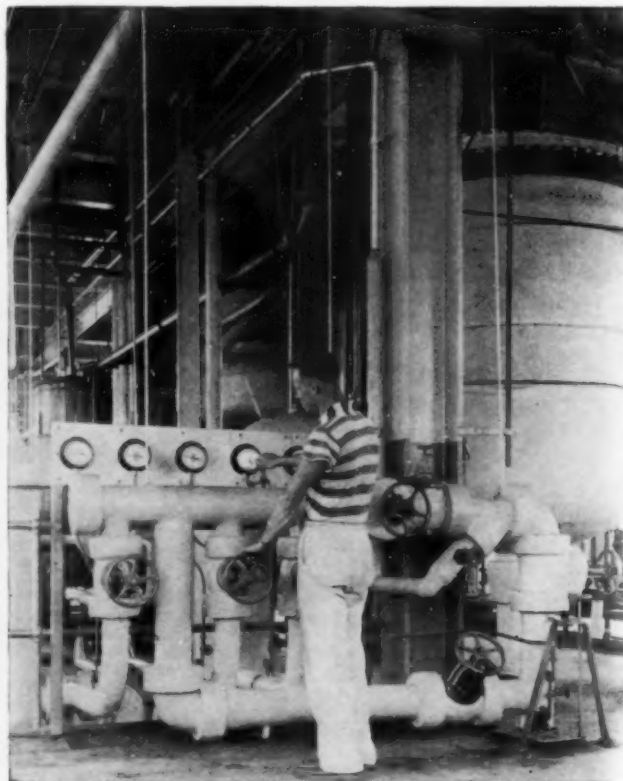
The top effluent, consisting of acetic acid, water, and an extractor, is fractionated to obtain the glacial acetic acid. The bottom effluent is likewise stripped to make certain that only water flows to the sewer. Numerous heat exchangers are used to accom-

plish the operation with very low steam consumption.

While Hercules produces three customary types of cellulose acetate—for molding powder, safety film, and lacquer—industry requires many variations of these; thus, users really require a "tailor-made" acetate, which the Hercules plant is capable of producing. Specifications in acetylation, viscosity, solubility, stability, color, clarity, uniformity, and freedom from haze and granularity are adequately met by the cellulose acetate produced in this flexible plant.

The story of Hercules cellulose acetate is more than a recital of operating features. It is an interesting portrayal of the progressive trend of the chemical industry—to determine market conditions—to study plant procedures; and, finally, to produce a product of the highest possible quality to meet the demands of industries that are ever on the alert to advance by making better products.

The recovery of acid is made as glacial acetic in a separate building by a counter-current cold extraction process, which is efficient and economical. Below are storage tanks on the ground floor of the building



One operator controls the operations of the entire acetic acid recovery system from a central point. While the use of methylene chloride reduces the volume of weak acid, nevertheless recovery is important

# Contrasts in Fiber Manufacture

*In recent months several articles in the technical press have dealt with one or another phase of the new glass fiber development of Owens-Illinois Glass Co. The present article is an attempt to examine the new manufacturing processes in comparison with those of the other great man-made fiber, rayon.*

IN 1917 the then microscopic rayon industry of the United States produced a total of less than 7,000,000 lb. of "artificial silk," a product which in those days was generally stigmatized as "synthetic" and enjoyed a large measure of popular unacceptance. In 1937, the same industry, grown to Gargantuan proportions, spun more than 330,000,000 lb. of continuous fiber and staple rayon together—products that the public wanted and recognized, not as synthetic "substitutes" but as new man-made fibers with properties never available in competing natural materials. In the 54 years since Char-donnet's first successful experiments, test tube fibers have progressed until they are not only among the most important products of the process industries, but among the most important raw materials of textile manufacturers.

Will the same thing happen to fibrous glass? The first to admit that any such tonnage as has been reached by rayon is hardly possible for glass textiles are the men who have developed and operated the new processes. They recognize that glass yarns and the textiles made from them are highly specialized products which are not likely to enter the clothing field. They recognize that these materials have special properties which will make their uses largely industrial for some time to come, in that they are proof against most corrosion, capable of withstanding high temperature and completely unburnable. With less than three years of development and commercial experience behind them, these materials have already obtained an enviable position in electrical in-

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sulation, while a considerable use in both gas and liquid filtration is evidently not far in the future. Decorative fabrics where fireproofness is essential is another field for which fibrous glass may have merit. But the possibility that today's men and women will find themselves clothed even partially in glass is extremely remote.

If glass fibers are unlikely, then, to encroach on rayon markets, they have at least some striking similarities and dissimilarities in manufacturing technique. One of the most interesting contrasts is in the speed with which successful commercial realization came to the two fibers. Glass textiles were known as a curiosity as early as 1893, but it was not until four years ago that anyone had serious expectations of a successful commercial process. Rayon, on the other hand, was born in 1884 and emerged in its first successful commercial realization from the semi-works laboratory of Char-donnet in 1890. Thirty years was required to assure the manufacturing future of the latter, and less than three for the former.

To one who is familiar with the manufacturing methods used in the various types of rayon manufacture, a trip through the fibrous glass plant of Owens-Illinois will prove even more illuminating than the relative development velocity. On the one hand you have an organic chemical industry operating on one of the most complex of organic compounds, cellulose; on

the other, a relatively simple inorganic material, subject to the closest chemical control, which in some forms has been used for centuries, its technology having made rapid progress in recent years. In the case of rayon you have an investment per pound of annual output probably larger than in any other field of process industry; in the case of fibrous glass, an investment per pound of output which is probably not much in excess of that required for the production of some of the more delicate and complex glass forms.

An interesting comparison is that of fiber diameters. Fibrous glass at present is being produced with individual filaments averaging within about 2 per cent of 0.00025 in. diameter. Should it be desired, this diameter can readily be reduced to 0.0002 in. and possibly even finer. On the other hand, both viscose and acetate rayons, in the finest sizes now spun, average 0.0005 in. diameter, while the finest viscose size which has ever been on the market, namely 100 denier-100 filament, had an individual filament diameter of approximately 0.0004 in. For comparison, silk fibers range from 0.0003 to 0.0005 in. (0.5-1.5 denier), while cotton fiber diameters are of the order of 0.0004 and the average human hair, 0.002 in.

It is also interesting to note that fine glass fibers have tensile strength comparable to that of steel, being in the neighborhood of 150,000 lb. per sq. in. for the 0.00025 in. fiber.

Both the simplicity of the glass fiber spinning equipment and the relatively small amount of floor space per unit of production are notable features to the man familiar with



Gas flame, chain belt conveyor and sliver guides of one of the staple fibrous glass machines on page 411

rayon manufacturing methods. One glass furnace and one marble forming machine can keep a large fiber glass spinning plant busy. The space required by a single 50-spinneret viscose spinning machine would provide room for fibrous glass equipment capable of turning out several times the poundage. Twisting departments for the two types of fiber are comparable as are the strictly textile departments in which tapes, tubes and fabrics are knitted and woven. But for glass there is no extensive chemical building, no coagulating bath recovery equipment, no dryers, no water problem or tremendous water consumption, no washing, no bleaching and little need for inspection. Fibrous glass, however, does have the problems inherent in high temperature operations.

A brief description of the actual processes used will make this contrast even more vigorous. Until very recently, staple fiber rayon was of no great commercial importance, the continuous fiber process being the only one on a large tonnage basis. Fibrous glass in its modern version, however, was developed first as a staple fiber and then very shortly thereafter as a continuous fiber, and both processes are now being actively operated. Differences in the requirements of the ultimate fabric determine which sort of yarn is to be used in a specific case.

Slightly the more complex of the two processes is the staple fiber process. Small glass marbles of one-third

or one-quarter ounce weight, of almost optical quality, are automatically fed at thirty second intervals to a small electrically heated furnace in which the glass is melted and maintained at an accurately controlled temperature. Marbles are used for a variety of reasons, not the least of which is the ease of inspection, which is essential. A single air bubble reaching the spinneret could upset production of that machine for several minutes, at least. A variety of glasses is employed including an alkali-free glass for electrical uses and low-alkali, soda-lime compositions for other purposes.

#### How Glass is Spun

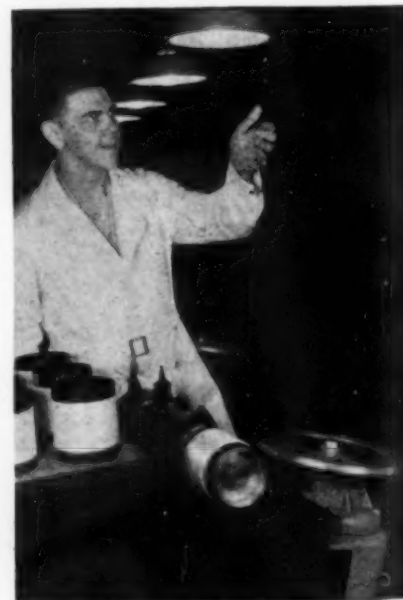
Molten glass, under a constant head in the melting furnace, discharges continuously through a spinneret comprising a row of 32 tiny orifices drilled in an electrically heated orifice plate made of a precious metal alloy. Directly below the orifice plate is a special form of steam jet discharging high pressure superheated steam in such a manner as to seize the molten glass threads and drag them downward at high velocity, decreasing their diameters to about 0.00025 in. The individual fibers are drawn out to lengths of 12-15 in. and projected downward through the path of a gas flame which serves to evaporate any moisture they may have accumulated from the steam. They then strike a moving chain belt conveyor as a mass of partially intertwined fibers which can be picked up from the conveyor, directed through guides and wound on a tube driven at constant peripheral speed. A simple traverse mechanism is provided to produce a well-wound package of sliver. After the package of sliver is removed from the machine, it is transported to the twisting department where it may either be twisted without reduction in size on standard ring twisters, or a number of slivers may be twisted together and drafted on standard cotton machinery.

Just as continuous rayon fibers are produced by drawing and so attenuating the fibers as they leave the spinneret, the continuous fibrous glass process draws its 102 filaments from the orifice plate, producing individual fibers of the same diameter as the staple fiber process. In this process a similar furnace to that used in the process described above is employed, but without the steam jets for drawing and attenuation. The fibers are

led through an "eye" and then wound on a bobbin rotating at a peripheral speed of 6,000 ft. per min. or more. This bobbin is carried on a shaft mounted in a heavy bearing to eliminate vibration and driven by a belt from a small individual motor through a Reeves variable speed drive. A most interesting feature of the continuous spinning machine is the traverse mechanism which differs markedly from anything at present used either in rayon or textile machinery. Many different traverse mechanisms were tried but none was found successful until what appears to be the simplest and most obvious possible mechanism was employed. The "eye" is set with relation to the bobbin so that the yarn pulls toward the right in the accompanying view. An aluminum disk which carries six projecting brass pins in its periphery is set in a substantially horizontal position above the horizontal center line of the bobbin so that as the disk rotates, each pin in succession meets the yarn as it returns to the right end and carries it gently but positively to the left end. The synchronization of bobbin and traverse is secured by driving both from the same motor.

Yarn spun by the continuous process is also transported to the twisting department where it is twisted on standard cotton machinery. Obviously, yarn of this type cannot be drafted so that the next step is coning, skeining, or warping.

Continuous filament strand of fibrous glass being wound on a package





Despite the apparent simplicity of the spinning process for fibrous glass in either the continuous or staple form in comparison with the operations of rayon, it is obvious that the glass operations require a high standard of precision control. Molten glass at approximately 2,500 deg. F., at which temperature it has a viscosity of about 1,000 poises (comparable with that of honey at ordinary temperature), is cooled 2,000 deg. F. and has its viscosity increased to  $10^{15}$  poises in about 1/500 second. One cannot regard such an operation as simple.

At the risk of boredom for those familiar with rayon manufacture, a brief description of the viscose process may be worthwhile for emphasizing the technical dissimilarities to the fiber glass processes. Just how the bulk of the staple rayon now being made is produced has never been told in detail. In the past, most of it was made by the ordinary filament process, with the continuous fibers cut to staple lengths. At present two continuous staple processes are in use, the dry and the wet, terms which describe the condition of the fiber when cut. In the first a spinneret containing several hundred orifices spins a continuous yarn which passes in succession through coagulating, washing and desulphuring baths, and finally a dryer and cutting mechanism. In the second, the hank of fibers is coagulated, then cut, then handled in bulk through the remaining baths and the

dryer. Lacking more complete information, only the continuous fiber process can be described here.

#### Rayon Complications

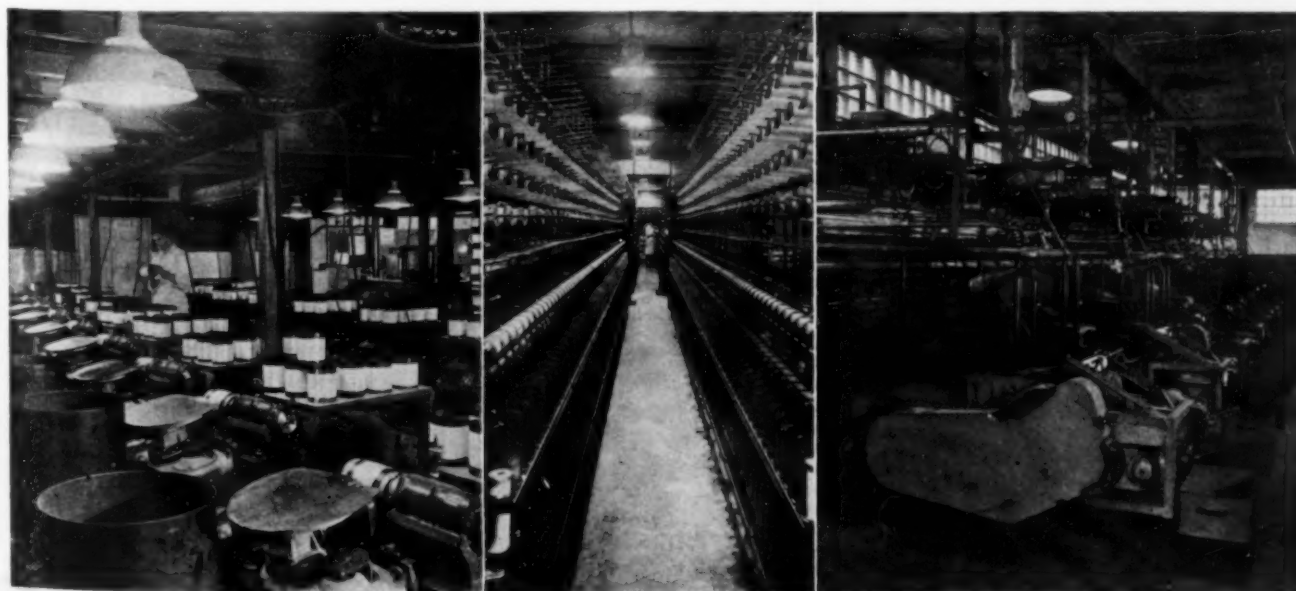
If we start as we did in the fiber glass process, that is, with the principal raw material, we enter the rayon process in the steeping room where sheets of cellulose are mercerized in caustic soda solution after which they are pressed as dry as possible, and discharged to shredders for disintegration into crumbs of alkali cellulose. These crumbs must then be aged under controlled temperature and atmospheric conditions and are finally charged into a rotating tumbling barrel or barratt where they are treated with carbon bisulphide for the production of the glutinous, orange-colored cellulose xanthate. The xanthate is dissolved in more caustic soda solution, aged at relatively low temperature, filtered or possibly centrifuged a number of times, de-aired and finally pumped to the spinning machines where it passes through an individual spinning pump for each spinneret. Past the pump, the viscose solution is again filtered and then forced through the holes of the spinneret into a coagulating bath consisting of sulphuric acid, sodium sulphate, glucose, zinc salts and a variety of other materials, depending on the particular manufacturer. From the bath it passes over guides, through a traverse and winds up on a rotating bobbin; or

passes over a rotating godet wheel, through a vertically reciprocating funnel and winds inside a rotating spinning bucket. In the latter process, twisting is accomplished simultaneously with the winding within the bucket. Rayon produced by both methods must then be thoroughly washed and desulphured, after which it is dried and passed to further operations such as rewinding prior to twisting, skeining or coning. Sometimes a washing and bleaching operation and always a careful inspection are required.

The purpose of this technical comparison, which in the main will appear to be highly unfavorable to rayon technique, has not been to derogate from the prospects of synthetic fibers other than glass. It should again be emphasized that the latter is a specialized fiber, probably competitive only in a very minor degree with rayon. But the comparison is instructive, not alone because it shows the lengths to which modern ingenuity can go when given favorable circumstances, but because it suggests also the possibility that thermoplastic materials other than glass may some day find their specialized textile uses.

In conclusion, a word of appreciation is in order to the engineers engaged in this development who supplied information, checked the manuscript and permitted the writer to inspect the operations, withholding little in the way of essential information.

Views in the fibrous glass plant of Owens-Illinois, showing, at the left, a section of the continuous fiber spinning department; in the center, an aisle between two rows of twisters; and, at the right, the staple fiber production room



# Polymerization and Its Economics

*Many technological advancements have been made in recent years in the polymerization of propane, butanes and other light hydrocarbons for use in motor fuels. Their economic significance is of great importance to the chemical engineer because it concerns the future of the largest of chemical process industries—petroleum refining.*

THE RAPID INCREASE in the number of motor cars has made heavy demands on the world's yearly and potential gasoline supply. Two developments in the refining industry have helped greatly to increase the gasoline yield. The first of these, the commercial cracking process, was introduced about 25 years ago and in 1937 accounted for 268,131,000 bbl. of cracked gasoline as compared to 251,507,000 bbl. of straight run gasoline and 48,550,000 bbl. of natural gasoline, corresponding to an annual saving of 1,500,000,000 bbl. of crude oil. The second, the polymerization process, developed only recently, has a potential supply of more than 15 per cent of the U. S. motor fuel output.

In the cracking process, long hydrocarbon chains are broken down to short ones to produce a more volatile product suitable for motor fuel and cracked gas as a byproduct. It is not possible to control the reactions so that only  $C_4$  to  $C_{12}$  chains are formed, i.e., the ones that compose gasoline. There are formed in addition, methane, ethane, propane and butane and a number of the corresponding unsaturates. These compounds, when alone are gases at normal temperatures, but a portion of them, especially those with the longer carbon chains, dissolve in the cracked gasoline and later tend to boil away, making the gasoline "wild" or "unstable." It is therefore necessary at the refinery to pass the gasoline into a stabilizer to eliminate most of the methane, ethane, ethylene, propane, propene and part of the butanes and butenes. The propane-propene and butane-butenes are the raw feed for the polymerization unit.

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Before the advent of polymerization in the oil industry these gases were used or sold as a low-priced fuel gas or were wasted to the atmosphere. As the anti-knock quality of motor fuel was improved by changes in the cracking process, the amount of by-product gases formed was increased until the economic disposal of these gases became an important problem. Polymerization not only helped to solve the problem of the economic utilization of the light fractions, but also helped to produce a superior motor fuel of high octane rating.

Polymerization may be looked upon as the reverse of cracking. Light hydrocarbons such as the  $C_4$  and  $C_5$  chains, normally gases, are combined to make longer chains which are suitable for motor fuel. In present commercial processes methane and ethane do not combine readily, so that it is mainly the propane and butanes that are polymerized into the heavier gasoline-range hydrocarbons.

An outstanding characteristic of gasoline produced by polymerization is its high octane rating. In 1928 motor fuel of 50-octane rating was in general use. From that time to the present the maximum automobile speed has increased from approximately 60 m.p.h. to over 100 m.p.h., and the cruising speed of airplanes has increased from 90 to 220 m.p.h. These increases in speed have been made possible to a large extent by higher octane motor fuels. At the present time automobile requirements

may be satisfied in most cases by fuels of a rating under 70-octane. For airplanes, however, fuels of 95 to 100-octane are desirable.

The types of polymerization processes now commercially available are definite aids in the production of high-octane fuels. These processes and their present applications may be summarized as follows:

1. The thermal polymerization of  $C_4$ - $C_5$  mixtures either saturated or unsaturated employing heat and pressure only. The resulting high-octane gasolines are used in the preparation of automotive fuel blends.
2. Catalytic polymerization of propylene and butenes. The resulting high-octane gasolines are used in automotive blends.
3. Catalytic polymerization of butenes followed by hydrogenation of the polymer. This operation furnishes the several iso-octanes which are used as blending agents with aviation base gasoline for the manufacture of high-octane aviation fuels.

In the production of gasoline from the light gases obtained as byproducts in the cracking process, it is necessary to induce two or more of the molecules of the light materials to combine to form new molecules containing five or more carbon atoms with a consequent higher boiling point. Propane and butane, however, are saturated hydrocarbons and are noted for their chemical inertness. Nevertheless a direct method has been discovered for making isobutane react with propene or butenes to make heavier hydrocarbons. Another process has been worked out to catalytically dehydrogenate propane or butanes into propene and butenes. These light paraffins are also subjected to heat and pressure for a suitable length of time and are broken

down into unsaturated compounds which are relatively active chemically. The unsaturates can then be made to combine with each other to form heavier compounds. This is accomplished either by a continuation of the heat-and-pressure treatment, or by the use of a catalyst. A large variety of reactions is possible but the following given by Wade<sup>1</sup> can be used to illustrate the general procedure (h, p, t represents heat, pressure, time):

**Breaking-down step:**

Feed: propane,  $C_3H_8 + h, p, t =$  ethylene,  $C_2H_4 +$  methane,  $CH_4$

Feed: butane,  $C_4H_{10} + h, p, t =$  propene,  $C_3H_6 +$  methane,  $CH_4$

**Polymerization Step:**

Ethylene,  $C_2H_4 +$  propene,  $C_3H_6 =$  pentenes,  $C_5H_{10}$  (B.P., approx. 92 deg. F.; Sp. Gr., 0.65) or

Propene,  $C_3H_6 +$  propene,  $C_3H_6 =$  hexenes,  $C_6H_{12}$  (B.P., approx. 130 deg. F.; Sp. Gr., 0.72)

These are but a few of the many reactions which actually take place, for a final product of an operation will contain everything from hydrogen gas to lubricating oils and even extremely heavy tars.

**Commercial Processes**

Two general types of processes are in commercial use: the catalytic process and the straight heat-pressure-time process. The first, called the U.O.P. catalytic process, is owned and licensed by the Universal Oil Products Co. The first commercial plant of this process for converting straight natural gasoline stabilizer discard (butanes) was placed in operation in March, 1937, at the plant of the Shamrock Oil and Gas Corp. in Texas.

The Unitary thermal polymerization process is owned by The Polymerization Process Corp. and licensed through its agent, The M. W. Kellogg Co. This process was developed jointly by Phillips Petroleum Co.,

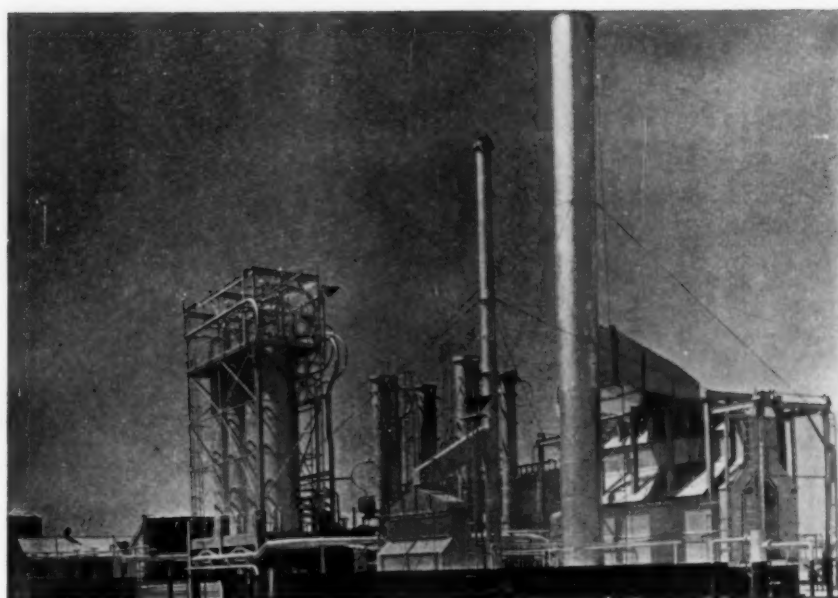


Fig. 2—A U.O.P. light hydrocarbon cracking and catalytic polymerization plant having a capacity of 1,100 bbl. per day of butanes

Standard Oil Co. (Indiana), Standard Oil Development Co., The Texas Co., and The M. W. Kellogg Co. It was first used commercially at the Alamo refinery of the Phillips Petroleum Co. at Borger, Texas, in 1933. The plant has been increased in capacity several times since then.

Both of these processes use an initial heat-pressure-time step to convert the incoming charge of paraffins more or less completely into unsaturates. In the U.O.P. catalytic process the fractionated products of the break-down are treated with a solid phosphoric acid catalyst to aid in the conversion to heavier products. In the thermal process the conversion of the light unsaturates into heavy ones is accomplished along with the initial break-down in one operation.

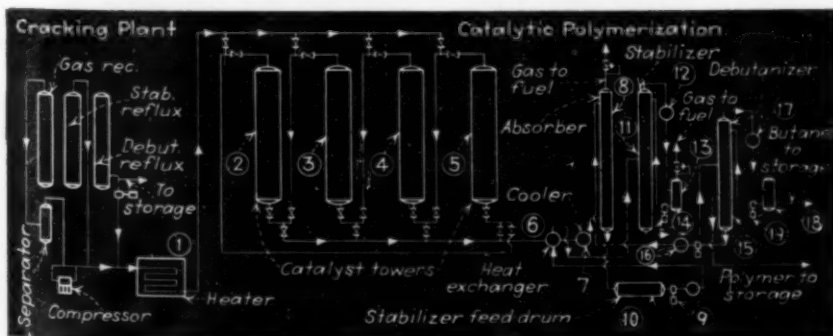
**U.O.P. Catalytic Process**—The catalytic polymerization process represents a very important step in the production of motor fuels, such as iso-octane, and in the production of chemical derivatives. A typical flow sheet of one catalytic process is shown in Fig. 1. The raw feed may consist of condensable overhead direct from the stabilizer in the cracking process, or the cracked gasoline may be passed through a debutanizer operated at a pressure of 100 lb. in which the cracked gasoline is further stabilized to a low vapor pressure, thereby obtaining additional feed stock for polymerization. Feed composition is usually about as follows:

Compound	Mol per cent
Methane	14 — 32.3
Ethane and Ethylene	21.7 — 24.6
Propene	12.8 — 15.4
Propane	20.1 — 32.5
Butenes	5.4 — 8.5
Butanes	6.0 — 8.0

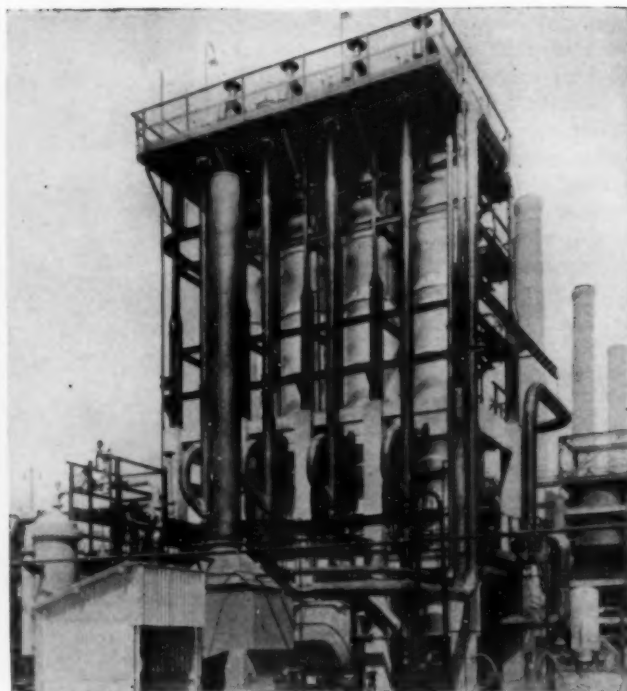
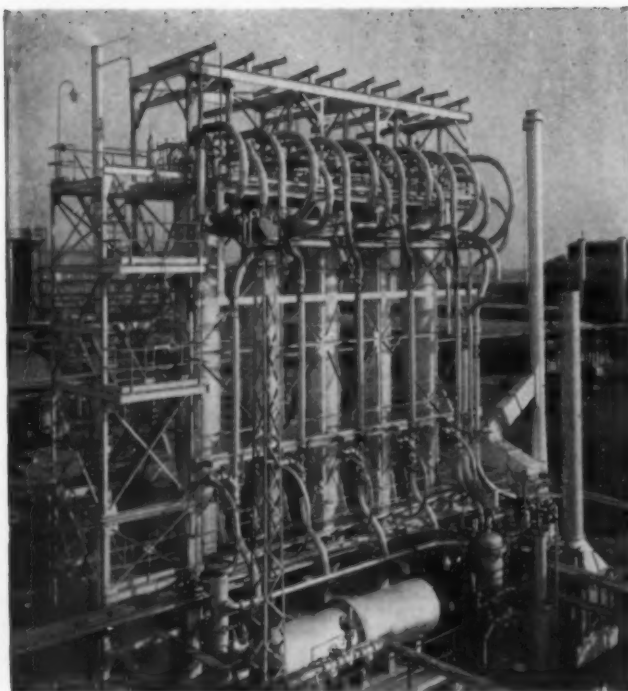
A feed having this composition is pumped to a heater (1) where the temperature of the mixed gases is raised to 375–400 deg. F. under a pressure of 300 lb. per sq. in. These heated mixed gases are then passed to three catalyst towers (2), (3), and (4) or (5) in series flow. The towers are packed with a solid granular phosphoric acid catalyst. Four towers are so connected that any three can be operated in series, the fourth being free for regeneration of the catalyst.

During the operation the activity

Fig. 1—Sequence of operations in the production of polymer gasoline by the Universal Oil Products Co. catalytic polymerization process







Figs. 3 & 4—A 2,500,000 and an 8,000,000 cu.ft.-per-day polymerization units using the catalytic process described below

of the catalyst is gradually reduced due to the formation of a covering of carbonaceous material around the solid phosphoric acid particles which must be removed periodically. This carbonaceous deposit is removed by controlled oxidation, followed by a steam treatment to re-hydrate the catalyst, which otherwise would be inactive. The catalyst must be reactivated in this manner after about each 60 days' service.

While passing through the catalyst towers the temperature of the gases is raised about 150 deg. F. due to the exothermic polymerization reaction.

The polymer product in gaseous form together with residual gases leaving the last catalyst tower passes through heat exchangers (6) and cooler (7) into an absorption column (8) operated at a pressure of 225 lb. Here the heavier portions of the polymer product are absorbed in a still heavier polymer product coming from the debutanizing tower (15). The residual gases go to the fuel system, while the liquid product passes out of the bottom of the column into a stabilizer feed drum (10), then through the heat exchanger (6) and into the stabilizer (11). The overhead from the stabilizer consists of propane, propene, and lighter gases and is too light for motor fuel. It is

circulated through cooler (12) and separator (13), with the heavier portion re-circulated to the stabilizer or sent to the catalyst system. The liquid portion from the bottom of the stabilizer flows to the debutanizer (15) which is operated at 100 lb. pressure. The gaseous  $C_4$  fraction containing over 10 per cent butenes passes through the cooler (17) and separator (18) on to storage. The lighter liquid polymer product, consisting mainly of  $C_4$  to  $C_{12}$ , classed as gasoline polymer, is removed from the tower as a side cut, and the heavier polymer bottoms pass through the cooler (16) to the top of the absorber (8) where they are used as an absorption oil.

#### Properties of Catalytic Polymer Motor Fuel

Property	(a) From Debutan- izer	(b) Re-dis- tilled and Treated
Gravity, deg. API.....	62.2	67.1
<i>ASTM Distillation, deg. F.</i>		
Initial boiling point.....	162	95
10-per cent point.....	189	156
20-per cent point.....	197	186
50-per cent point.....	226	221
80-per cent point.....	290	280
90-per cent point.....	332	329
End point.....	435	376
Recovery, per cent.....	98.5	95.5
Residue, per cent.....	1.0	0.5
Loss, per cent.....	0.5	4.0
R Reid vapor pressure, lb..	2.7	10.8
Octane number.....	82.0	82.0

Polymer gasoline may be sweetened and blended directly with gasoline or may be converted to a water-white product by distillation. The accompanying table based on the paper by Egloff, Morrell and Nelson<sup>2</sup> shows the properties of the product (a) as received from the debutanizer (15) and (b) after it is re-distilled, doctor-sweetened, and blended with butanes to the desired vapor pressure. Figs. 2, 3, and 4 show present day units.

**Unitary Thermal Process**—One form of the Unitary thermal process is shown in a simplified flow sheet in Fig 5a. The feed, consisting of liquid stabilizer discard, enters the high pressure primary fractionating tower (1). In this tower  $C_3$  and heavier natural gasoline components of the fresh charge are removed as bottoms together with polymer liquid. The  $C_4$  and lighter fractions from the fresh feed plus recycle constituents from the coil outlet pass overhead through a water cooled condensing system to the accumulator or storage tank (2). In the accumulator the lighter gases, mainly  $C_1$  and  $C_2$  escape while the liquid is pumped through the cold side of heat exchanger (3) to the polymerization coil (4) in the furnace (5). The hot furnace product goes through the heat exchanger (3) through a re-boiler in the bottom of the primary

fractionating tower and then is introduced into the midsection of the same tower.

In this tower the  $C_4$ 's and lighter fractions are removed overhead to the accumulator (2). The polymer liquid together with the natural gasoline from the fresh feed leaves the bottom of the tower and is transferred to the low-pressure polymer fractionating tower (6).

The polymer tower separates the polymer gasoline to the desired end-point specifications overhead and any heavy tar as bottoms. Gasoline overhead passes through a clay treating system, a clay polymer separator and on to storage.

Another modification of the unitary system is shown in Fig. 5b, in simplified form. The feed, liquid stabilizer discard, passes into the accumulator or storage tank (1), through the heat exchanger (2) and the reaction coil (3) in the polymerization furnace, and then into the primary fractionating tower (4). In this tower all materials too light for use in the final product, including unconverted propane and butane are taken overhead and sent to the gas recovery system (5), which may consist of a conventional compression or absorption system.

In the recovery system all materials lighter than ethylene are separated and discarded. Two liquid fractions are separated: One consists of propane and butane and the corresponding unsaturates which are passed on to the accumulator to mix with the incoming feed; the other consists of the heavier unsaturates which are sent to the primary fractionating tower below the feed tray.

Bottoms from the primary fractionating tower are fed to the polymer fractionating tower (6) where the materials within the gasoline boiling range are taken overhead and condensed to make polymer gasoline.

Heavier materials leaving the bottom of the tower are recycled to the primary tower (4) or are used as gas oil or fuel oil.

The yields obtained in the polymerization processes depend upon the process used and the nature of the charge. Carey<sup>3</sup> has made an analysis of yields for the Unitary thermal process. On a charge consisting of 49,000 cu. ft. of gas containing 56.6 per cent by weight of  $C_3H_8$  and 43.3 per cent  $C_4H_{10}$  and weighing 6,358 lb., there was obtained a yield of 480 gal. finished 400 deg. F. end-point polymer gasoline. This amounted to 2,930 lb. or a yield of 46 per cent. In another run consisting of 47.4 per cent by weight of  $C_3H_8$  and 52.6 per cent  $C_4H_{10}$ , a finished yield of 53.4 per cent by weight finished gasoline.

For the U.O.P. process figures have not been made available. Wade gives a yield of about 45 per cent by weight for the combined pyrolytic and catalytic operation, using practically pure fractionated butane for feed.

#### Plant and Production Costs

It is not possible to give anything but general figures on the total cost of a polymerization plant. Assuming a supply of raw material available for the feed, Wade<sup>1</sup> estimates the investment at approximately \$300,000 for a plant handling 1,000 bbl. per day of raw feed, and \$450,000 for a plant of double the capacity. This does not include storage facilities for producing about 800 b.h.p. for steam nor for providing compressed air for regenerating the phosphoric acid catalyst. In addition considerable investment may be required in the refinery for producing the raw polymerization feed. This includes such items as an increased oil-circulating capacity of the gasoline plant to obtain the necessary extraction of butane or butane and propane. The plant costs per unit of gasoline pro-

duced is probably nearly the same for the two basic polymerization processes operating at equal gasoline capacities.

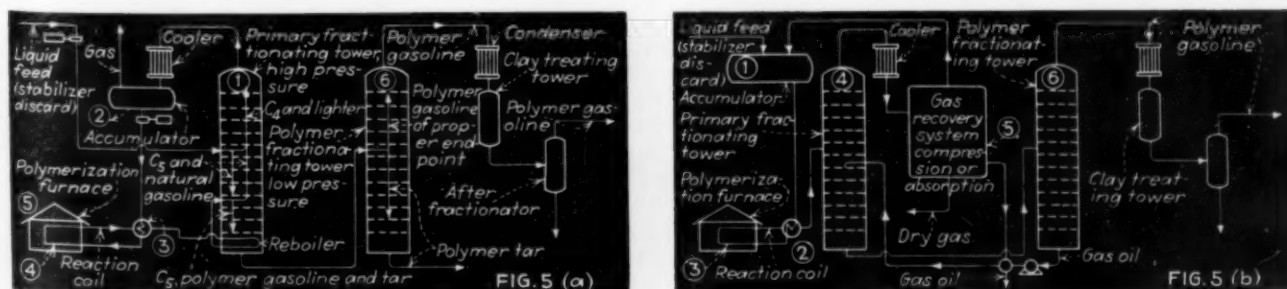
Net cost of polymer gasoline varies from 3.5c. to 5.5c. per gal. depending on the size of the plant and the value of the raw feed. The value of the latter may be considered at 1c. per gal. and in some cases as low as 0.9c. per gal. If, however, there is a market for the raw feed, the cost may be considerably higher. A charge of 20 per cent for depreciation and obsolescence is probably not high.

Cost of producing polymer gasoline will depend for one thing upon the size of the plant. Where gas is used a small plant will treat 1,500,000 cu. ft. of raw gas per day, producing 250 bbl. of polymer gasoline. Plants are in operation treating over 13,000,000 cu. ft. of gas per day. If the raw feed is liquid (mainly butane) plants are in operation using over 1,300 bbl. of butane-butene mixtures, producing approximately 350 bbl. of iso-octanes. The octanes are catalytically hydrogenated to iso-octanes having an octane rating of 90 to 100.

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Fig. 5—Two alternate forms of the Unitary thermal polymerization process now used extensively for production of motor fuel



# Cleaning Up Refinery Gases

*Not only corrosion and nuisance elimination but also an economical source of sulphuric acid is what refineries can secure from improved hydrogen sulphide removal systems. One from Germany and three of the most modern in use in this country are described briefly. Two of these are applicable to carbon dioxide.*

AS REFINERIES turn their attention to the production of polymer gasoline, liquefied gases, and various organic chemicals from light hydrocarbon gases, the removal of hydrogen sulphide from these gases becomes an increasingly important process. Also, interest has been aroused during the past two years by development of purification processes capable of recovering hydrogen sulphide of sufficient purity to be converted to sulphuric acid by any of the conventional means, thereby converting a nuisance into a profitable byproduct. The outstanding characteristics of four of the more important hydrogen sulphide and carbon dioxide recovery processes are described in the following abstracts of papers from the American Petroleum Institute's May meeting in Wichita, Kans.

## Alkacid and Claus Processes

Solutions having exceptionally high absorptive capacities for carbon dioxide and hydrogen sulphide have been developed by the I. G. Farbenindustrie of Germany. As described by Hans Baehr of that organization, these consist of the aqueous solutions of alkali salts of weak organic acids such as aminosulfo acids and aminocarbonic acids. They are in wide commercial use in Germany.

Three of the solutions, each of which have a specific field of application, have been developed and put on the market under the name "Alkacids." Alkacid M is used for the removal of hydrogen sulphide and carbon dioxide, either separately or simultaneously. Alkacid Dik is used for the selective removal of hydrogen sulphide from gases containing car-

bon dioxide, and Alkacid S removes hydrogen sulphide and carbon dioxide from gases containing impurities such as tar, dust, and certain other gas constituents. The selectivity of the solutions depends upon their composition and upon the physical conditions employed, such as time of contact and temperature. Shaking tests showed Alkacid M to have a considerably higher absorption rate than 50 per cent triethanolamine, 30 per cent potassium carbonate, 22 per cent tripotassium phosphate and 10 per cent sodium carbonate.

Shown in Fig. 1 is a flow diagram of the Alkacid process combined with the Claus process for the conversion of recovered hydrogen sulphide into free sulphur by the action of a catalyst. The gas to be purified is scrubbed in the absorber tower countercurrently with cold reactivated Alkacid solution, which absorbs the hydrogen sulphide and carbon dioxide and collects in the lower section of the tower as a saturated solution. This is pumped through a heat exchanger in which it is heated to 80-90 deg. C., and then enters the top of the reactivating column where it is stripped of its absorbed constituents by steam. The hot reactivated solution is withdrawn from the bottom of the column, cooled to 40-50 deg. C. by heat exchange with the used solution from the absorber tower, and after further cooling is returned to the top of the scrubbing tower. The hydrogen sulphide released in the reactivator goes to the Claus process where the first step consists of burning with air in a tubular boiler to form sulphurous acid. The vapors

from the boiler at 250 to 300 deg. C. are passed over a catalyst in a Claus contact oven where the sulphurous acid and remaining hydrogen sulphide are converted into sulphur. The sulphur separates out in liquid form partly in the sump of the oven and partly in the centrifugal separator. A 92 to 94 per cent yield is obtained, based on the hydrogen sulphide fed to the boiler.

At present the amount of hydrogen sulphide removed from gases by the Alkacid process in Germany corresponds to more than 30,000 metric tons per year of sulphur, or more than half of the total German sulphur production.

## Sodium Phenolate Process

The Koppers phenolate process for recovering hydrogen sulphide from gas mixtures, described by G. M. Carvlin of the Koppers Co., has been in commercial operation for approximately two years. The absorption agent used is a solution of sodium phenolate which is continuously regenerated by steam. The concentration of the solution depends upon the amount of hydrogen sulphide to be removed and the degree of removal desired.

The hydrogen sulphide recovered is in practically pure form—95 to 99 per cent, exclusive of water vapor—and is suitable for conversion to sulphuric acid in a conventional type acid plant. Acid of 66 deg. Be. concentration may be produced from a typical refinery gas at a total operating cost of \$3.25 per ton, with no credit allowed for purified gas or for reduction of maintenance or elimination of atmospheric pollution. In the typical case cited, the investment



for purification plants and acid plants is amortized in two years.

The present installed capacity of phenolate plants in this country is approximately 55 million cu. ft. of gas per day. Sulphur production capacity is 26,000 tons per day, which is equivalent to 75,000 tons of 66 deg. Be. acid.

#### Shell Phosphate Process

An aqueous solution of tripotassium phosphate is used as the absorbent in the Shell process, described by T. W. Rosebaugh of the Shell Development Co. The gas to be purified is scrubbed with the solution in a conventional bubble plate or packed absorber, and reactivation is affected by boiling the solution. The solution runs from 40 to 50 per cent by weight of tripotassium phosphate and is prepared at the plant from commercial grades of potassium hydroxide and phosphoric acid.

A fact peculiar to the phosphate process is that the equilibrium vapor pressure of hydrogen sulphide over tripotassium phosphate solution for a given hydrogen sulphide saturation is greatly reduced upon diluting the solution with water. Advantage of this is taken by introducing the solution in two different concentrations at two different heights in the absorption tower (Fig. 2). The bulk of the hydrogen sulphide is absorbed in the lower section of the tower with a 40 to 50 per cent solution, while the more difficult absorption at lower hydrogen sulphide concentration is accomplished in the upper section with a relatively dilute solution.

The system of using different concentrations of absorbent makes it unnecessary to reactivate all of the solution to the lower degree of hydrogen sulphide saturation required for a low hydrogen sulphide content in the treated gas. The dilute solution entering the top of the absorption tower is obtained by mixing the water condensate from the reactivator with a small amount of the reactivated solution. The greater portion of the reactivated solution is returned to the lower section of the absorber.

In March of this year Shell process installations were operating in the Martinez and Dominguez Refineries of the Shell Oil Co., the East Chicago Refinery of the Shell Petroleum Corp., and the Norwalk Refinery of the Wilshire Oil Co.

#### Girbotol Process

The use of a one component absorbent is the outstanding characteristic of the Girbotol purification process, described by W. R. Wood and B. D. Storrs of the Girdler Corp., Louisville, Ky. In this process the hydrogen sulphide and carbon dioxide react with aliphatic amines such as mono- and triethanolamine to form compounds which may be broken down into their original components by heat.

The Girbotol cycle consists of a countercurrent absorption tower, heat exchanger and a reactivator tower in which the sulphide-laden solution passes downward countercurrent to low pressure steam from a reboiler. Because the amines used have high capacities for acidic gases, dilute

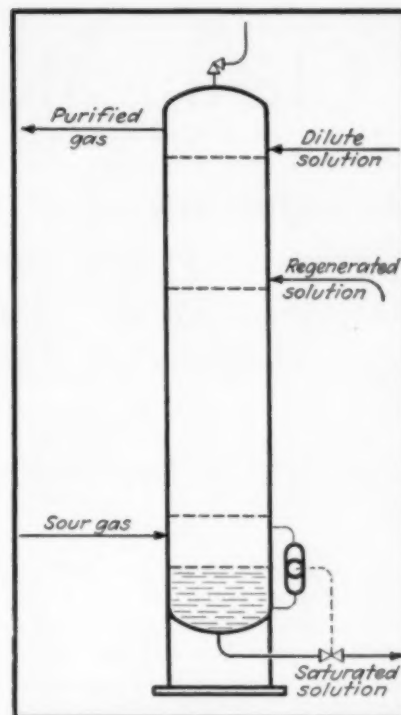
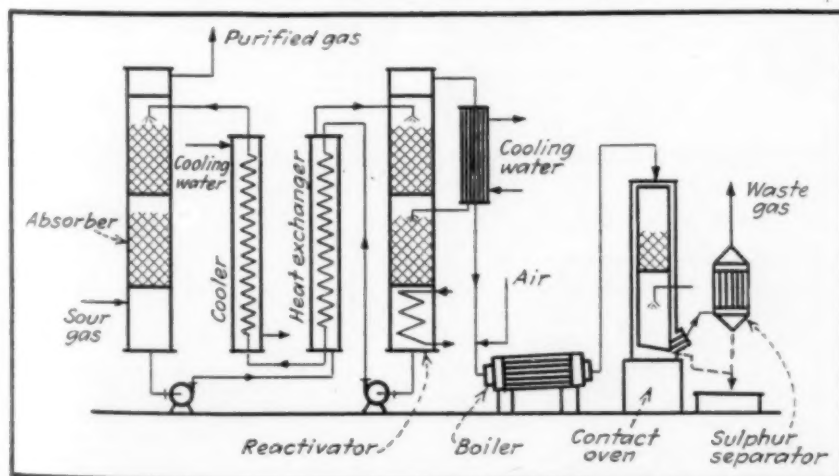


Fig. 2—Absorption tower used in Shell phosphate process. Tripotassium phosphate solution is the absorbent

Fig. 1—Flow diagram of Alkacid  $H_2S$  recovery process combined with Claus process for converting  $H_2S$  to free sulphur



water solutions may be used as the circulating medium. Since the absorbing solution is a single component, there is no exact pH or acid-alkali balance to be maintained. This is important where there is a gradual accumulation of a fixed acid in the solution. The effectiveness of the available absorbent is not altered by partial neutralization of the solution or by variation in solution strength.

The Girbotol process is used extensively in this country, and it is claimed that in all installations the hydrogen sulphide removal is better than 99 per cent. In some cases, particularly in the treatment of natural gas, it is desirable to remove not only the hydrogen sulphide, but also the water from the gas. This is accomplished by substituting a dehydrating agent for water in the Girbotol solution. Diethylene glycol is the agent being used at present.

Dehydration prevents the formation of hydrocarbon hydrates in transmission lines and the attendant reduction in line capacity. By controlling the ratio of diethylene glycol and water in the absorbing solution, the moisture content of the treated gas may be adjusted to any desired point from complete saturation to practically zero.

# Chemical Dehumidification of Air

*Dehumidification of air and gases by adsorption and absorption, only recently developed on a general industrial scale, suggests interesting possibilities for improving the thermal efficiency of drying processes. The mechanics of the method and some of its advantages and disadvantages in connection with drying are told.*

ALTHOUGH THE USE of chemical drying agents for dehumidification of air and gases in industry has been practiced for a considerable time, it is comparatively recently that manufacturers of equipment have developed units suited to general industrial application.

We shall limit the discussion to such applications as have the drying of materials in view, leaving out the drying of gases, per se, comfort conditioning and other uses to which drying agents have been put.

Except when dealing with small quantities the advantages of continuous drying processes over batch drying are obvious and account for their rapid acceptance by industry. In the low temperature drying field, however, the adoption of continuous drying was limited owing to the high cost of conditioning the air or the drying gas. Vacuum drying, even though it left much to be desired in many instances, was still less costly to employ.

It is very desirable to operate a drying process at uniform output rates under all weather conditions. With materials which can assume high temperatures without ill effect, this is not difficult to accomplish. We know from experience, and it can be easily shown on a psychrometric chart, that when we dry materials which are damaged at temperatures a little above 100 deg. F., the output rate is considerably affected by the dew point of the air with which we dry.

To overcome this, in quite a number of instances, recourse has been taken to refrigeration in order to lower the dew point of the air prior to its admission to the dryer. However, even with low cost refrigera-

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tion and where reserve capacity was available, this was considered costly. The costs increased rapidly the lower the dew point to which the air had to be conditioned. In Fig. 1 the power consumption per pound of moisture removed from air containing 0.015 lb. water per pound of dry air (which corresponds to a dew point of 69 deg. F.) is plotted against the moisture content of the dehumidified air.

A diagram such as that in Fig. 1 may be drawn for any existing conditions in a plant in order to investigate the most economical method of dehumidification. This comparison does not take into consideration that with refrigeration the air is delivered in a saturated condition and must be heated in order to make it suitable for drying. On the other hand, dehumidification with a drying agent will, in many cases, deliver the air in the condition required for drying.

With a view to future developments, dehumidification with a drying agent finally offers interesting possibilities with respect to improving the thermal efficiencies of drying processes, as we shall see further on.

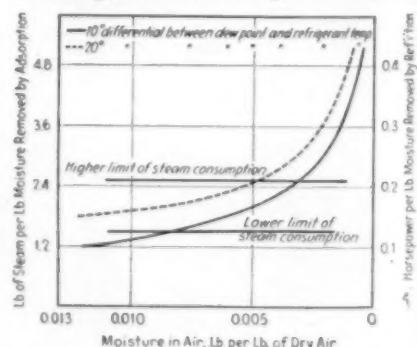
### Kinds of Drying Agents

Before further discussion of the application of dehumidification to drying processes we shall have to know something about the drying agents and how dehumidification is accomplished. Drying agents are divided into two classes according to whether the moisture is absorbed by virtue of the agent's affinity for water as a

solvent, or adsorbed as a result of a capillary adsorption action resulting from an extreme porosity.

To the first class belong a large number of organic and inorganic chemicals, both solid and liquid. The absorption may take place accompanied by chemical reaction in which case we are interested only in those chemicals which form compounds in which the vapor pressure of the water constituent is appreciably lowered. When no chemical reaction takes place, the vapor pressure is a function of the water in the composition. While many of the desiccators in this class have been used in the laboratory for many years, only a few meet the requirements of plant scale operation. Besides being capable of lowering the water vapor appreciably, they must be stable, as nearly non-corrosive as

Fig. 1—Power consumption per pound of water removed from initial air containing 0.015 lb. water per lb. dry air



Note—On the above graph, the comparison of steam consumed in a refrigeration process with that for stripping the moisture from the adsorbent in an adsorption process has been obtained by considering 1 brake horsepower for refrigeration as the equivalent of 12 lb. of steam for stripping.

possible, non-poisonous, non-combustible, capable of being readily re-concentrated or regenerated at comparatively low temperatures, and they must be inexpensive. Meeting these requirements, calcium chloride and lithium chloride, used both as solids and as solutions, are among the best known of the group of adsorbents involving chemical reaction.

We are all familiar with any number of hygroscopic materials. They absorb without chemical reaction. It can be seen from Fig. 2 that for these materials (such as cotton) the ratio of partial vapor pressure of the air in equilibrium with the material to the total vapor pressure at the same temperature, changes rapidly with the moisture concentration in the material, as indicated by the steep slope. They make poor drying agents. The characteristic of the curve for glycerin in the same figure is much more favorable in this respect. Industrial application of glycerin as a drying agent, however, requires great care in operation and equipment in order to keep the losses of this comparatively expensive material at a minimum.

One of the longest known adsorbents is activated carbon. Because of its powder form, limited regeneration capacity and combustibility, it is not considered a suitable drying agent in the sense referred to here. Silica gel was the first practical adsorbent for commercial dehumidification. It was introduced as such at the beginning of the last decade. Activated alumina is an adsorbent of much more

recent date. That it can remove moisture to a lower concentration than silica gel is immaterial for our consideration because in partial dehumidification we stay considerably above the concentrations at which this question is a decisive factor.

#### Characteristics of Drying Agents

Fig. 2 shows how adsorbents differ from other drying agents in their hygroscopic behavior. They adsorb moisture at practically 100 per cent efficiency (nearly 0 per cent relative humidity) until a break point is reached at a moisture concentration above which the efficiency drops off sharply. For silica gel the break-point concentration is lower for higher temperatures. At 50 deg. C. it is only one-third that at 25 deg. C. The adsorptive capacity of activated alumina is similarly affected by temperature, although to a lesser extent. At 50 deg. C. it is about half. Therefore care must be exercised not to allow the beds of adsorbents to be heated by the latent heat released in adsorption to a temperature at which the break point would be reached for the maximum working concentration. At the same time consideration must be given to the fact that the moisture concentration of the adsorbent coming first in contact with the air is much higher than the average moisture concentration in the adsorbent bed. The slower the gas flow, the greater will this difference be because of the time element involved in the diffusion of the moisture to the inside.

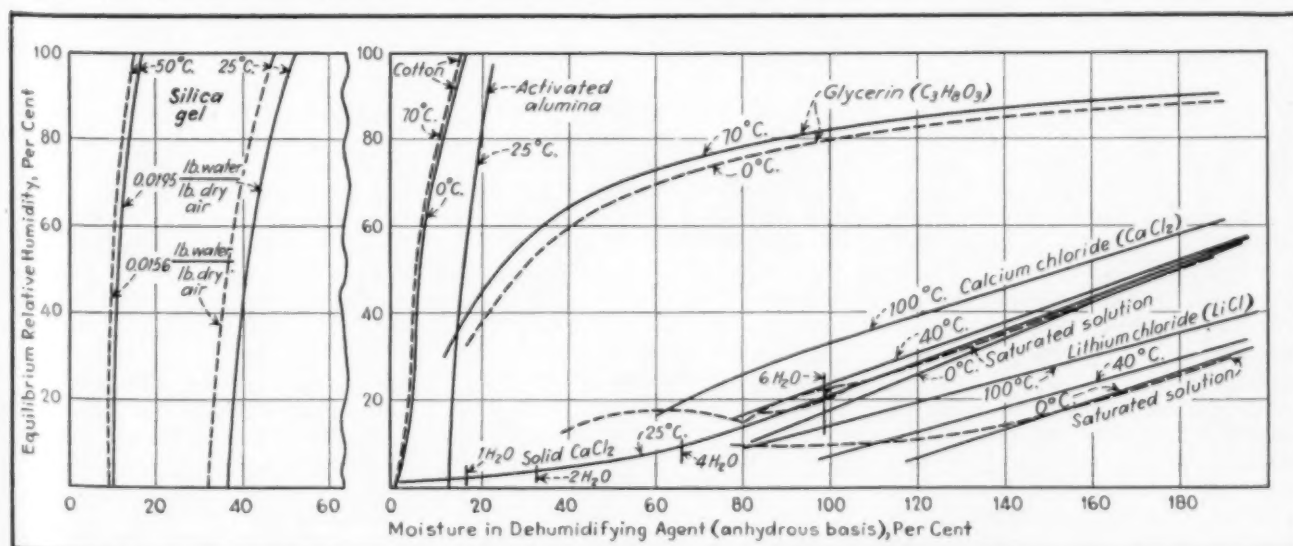
It seems logical, therefore, to em-

ploy cooling of the adsorbent when the moisture to be removed from the air is high, thereby maintaining the adsorptive capacity of the adsorbent.

The silica gel curves show how the adsorptive capacity is affected by the humidity of the air to be dehumidified. At 25 deg. C. the break point is at 32 per cent when the humidity is 0.0156 lb. of water per pound of dry air (8 grains per cubic foot at 25 deg. C.) as compared with 37 per cent when the humidity is 0.0195 lb. water per pound of dry air (10 grains per cubic foot at 25 deg. C.). At the higher temperature the lowering of the break point is proportionally smaller. Activated alumina behaves likewise but the change is of a much smaller order.

Going back to adsorbents, we see in Fig. 2 that the less the slope of the curve, the more the moisture concentration can be varied with less corresponding change in relative humidity. For glycerin at 0 deg. C. a variation in concentration from 80 to 120 per cent (anhydrous basis) corresponds to a change in equilibrium relative humidity from 76 per cent to 83 per cent. We also note that change in temperature has little effect on the equilibrium relative humidity. With such an adsorbent it is therefore possible to remove much moisture and the corresponding amount of latent heat per unit weight of adsorbent without much variation in the condition of the dehumidified air. What makes calcium chloride and lithium chloride desirable adsorbents is the small slope they present in the curves

Fig. 2—Adsorption and absorption curves for various drying materials (data from miscellaneous sources and Int. Crit. T.)





in Fig. 2 at low equilibrium relative humidities and the slight displacement of the curve for a considerable temperature change. Note, however, that these isotherms converge with increasing dilution; the less concentrated the solution the less the variation in relative humidity with changes in solution temperature. Within the practical temperature range, from 0 to 40 deg. C., the relative humidity is practically only a function of the solution concentration. Hence we can select the solution which will give us dehumidified air of a certain relative humidity.

The 25 deg. C. isotherm for calcium chloride in Fig. 2 is extended to the left to include the solid phase. In this condition the absorbent is deliquescent, the melting point dropping rapidly with moisture absorption. This

material does not lend itself to regeneration. Its use as a drying agent is limited to those applications in which the amount of moisture removed from the air is comparatively small. It will absorb from 25 to 50 per cent of its weight, according to temperature, before it will melt and have to be replaced. Being very low in cost, it may be economical in certain cases to use solid  $\text{CaCl}_2$  in that way. By combining it by a patented process with activated carbon its useful absorptive capacity was increased to 80 per cent of its weight.

#### Use of Psychrometric Chart

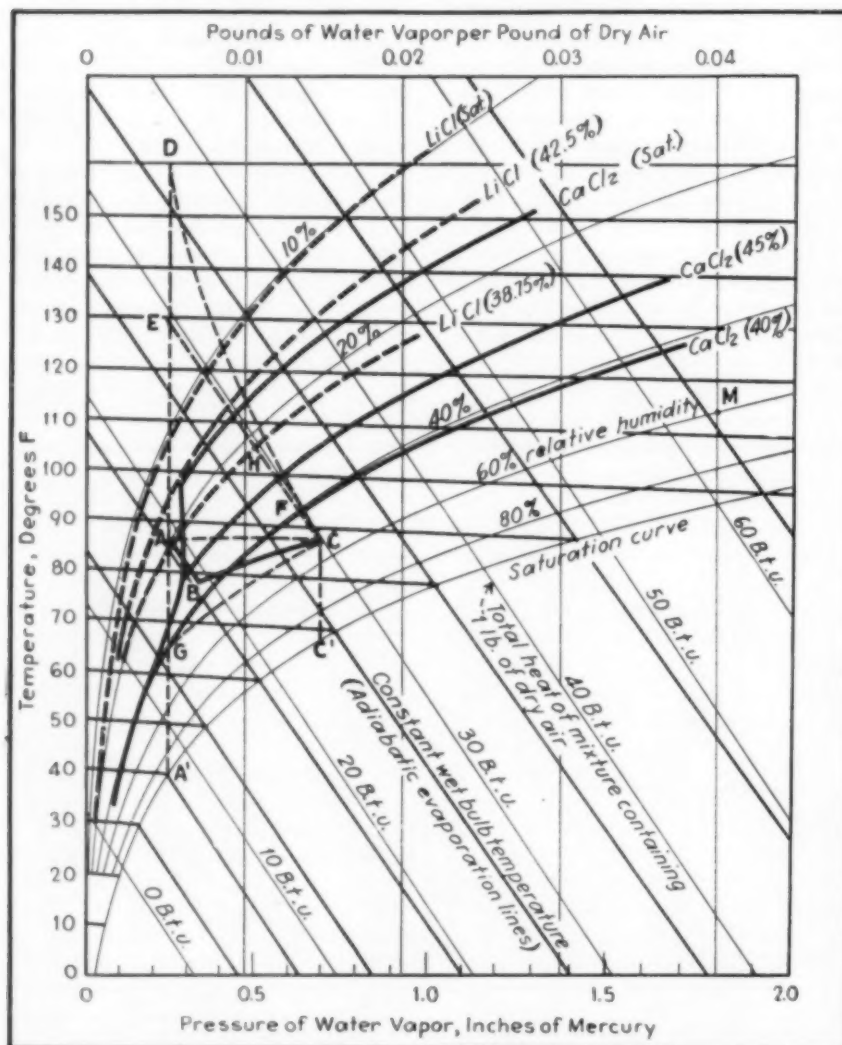
The data in Fig. 2, when transferred to a psychrometric chart, greatly facilitate the graphical solution of dehumidification problems. Fig. 3 shows the absorption curves

for lithium chloride and calcium chloride, for both saturated and dilute solutions, entered on the water-air mixture chart (see A.S.M.E. Trans., Jan. 1935) which is especially suited for our purpose in that it permits the direct reading of all the pertinent data. In this chart, the constant wet bulb temperature lines are also adiabatic absorption lines in so far as the diluted solutions are concerned. For the saturated solutions the adiabatic absorption lines would have slightly steeper slopes on account of the perceptible heat of dilution which must be added to the latent heat of condensation. For the solid hydrates the slope would be steeper still, about 0.017 lb. of water condensed per pound of dry air per 100 deg. F., due to the additional heat of hydration. For practical purposes the solutions used will have concentrations sufficiently below saturation to preclude the possibility of the solute crystallizing out. Therefore, we need not concern ourselves with adiabatic absorption lines other than those which coincide with the constant wet bulb temperature or adiabatic evaporation lines.

For adsorbents we use the left hand ordinate as the adsorption curve, since in practice we avoid operation above the break point. On account of the heat released in adsorption the adiabatic adsorption lines have steeper slopes. There are no published data on heats of adsorption for the adsorbents with which we are concerned, hence the omission from the chart. However, the error will not be of any consequence if the same slope is used as for the adiabatic evaporation lines.

In Fig. 3 the dehumidification process is shown graphically in connection with a drying process which follows the path ABC. Air leaving the dryer with a dew point of 69 deg. F. (point C) is to be recirculated after dehumidification to 40 deg. F. dewpoint (point A). Dehumidification along the adiabatic adsorption or absorption line CE assumes that only the latent heat of condensation raises the temperature of the air. Actually, conditions are seldom such as to make dehumidification along line CE possible. In case an adsorbent is used without cooling and the reactivation temperature of the adsorbent not brought down before the adsorption cycle is repeated, the air will pick up additional sensible heat from the adsorbent bed, dehumidification taking place along line CD. With cooling of the adsorbent bed, dehumidification

Fig. 3—Water-air mixture chart with absorption curves for lithium chloride and calcium chloride solutions. This chart gives by direct reading all the pertinent data for solution of dehumidification problems



can be accomplished along line *CA* or the air is dehumidified to a point between *E* and *A* and brought to the desired temperature in an aftercooler.

A typical arrangement for an adsorption installation is shown in Fig. 4. Usually several dehumidifiers adsorb while one reactivates. One arrangement in which the adsorbent beds rotate, is capable of removing about 600 lb. of water per hour at an air flow rate of 15,000 cu.ft. per minute. The equipment stands 16 ft. high and occupies floor space of less than 16 ft. square.

Suppose we were to use a calcium chloride solution to dehumidify the air from point *C* in Fig. 3. We see that in order to reach the desired dew point we would have to use about a 40 per cent solution, dehumidification progressing along line *CG* if the solution is cooled within the dehumidifier to maintain it throughout at a temperature below 65 deg. F., or approximately along line *CFG* if we dehumidify counterflow with the solution, the latter entering at a temperature below 65 deg. F. If water to cool the solution to such a low temperature is not available, we shall have to carry the dehumidification with calcium chloride solution only as far as the cooling water temperature will permit and complete the dehumidification with solid calcium chloride. The melted calcium chloride, after it is spent, is used partly for make-up of lost solution. With lithium chloride we can dehumidify along line *CA* if internal cooling is employed, or along line *CHA* with counterflow using a 39 to 40 per cent solution. The cooling water temperature is no problem in this case.

Fig. 5 shows a typical installation diagram for dehumidification by absorptive solutions.

#### Advantages in Drying

The foregoing should give a fair idea as to how partial dehumidification is accomplished on a plant scale. We can now discuss its advantages in connection with drying, as we started out to do.

The drying process *ABC* shown in Fig. 3 represents the first stage of a drying installation in which the wet material would be damaged if heated higher than 65 deg. F. Most materials which require low drying temperatures do so only in the wet state, permitting the application of higher temperature (for which dehumidification is not required) after they have lost part of the initial moisture.

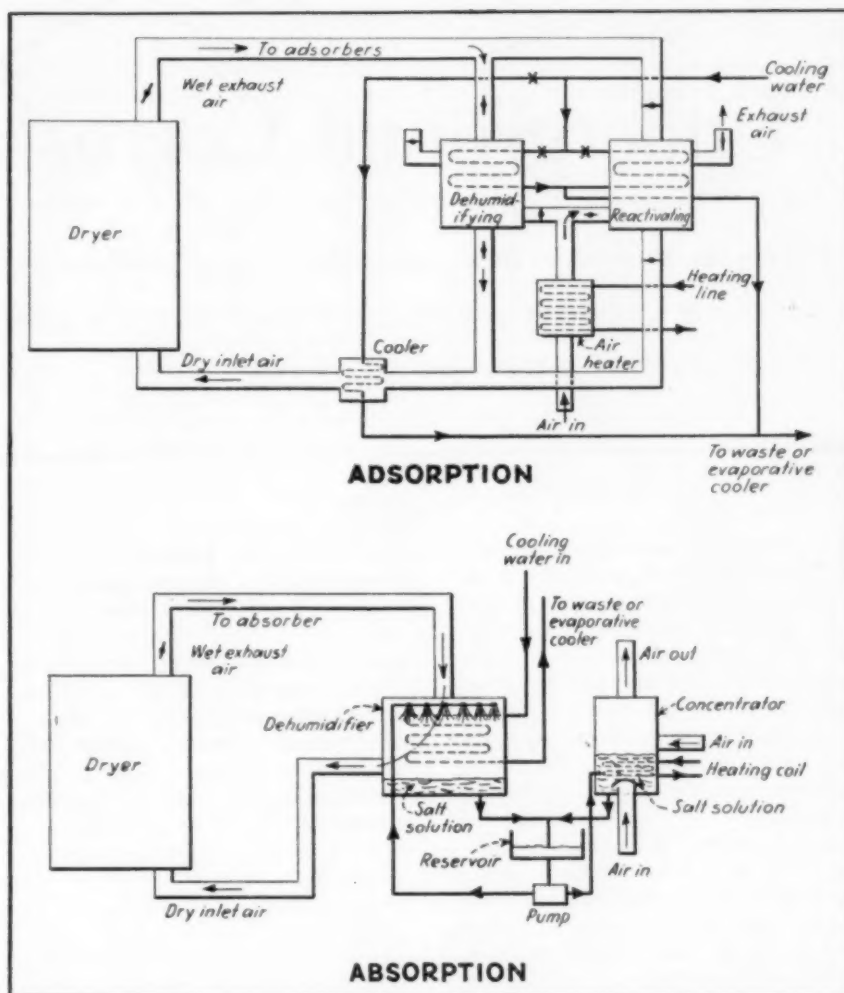


Fig. 4 (top)—Typical arrangement for an adsorption installation for dehumidification of air from a dryer. Fig. 5 (bottom)—Typical installation diagram for dehumidification by absorptive solutions

Let us now assume a drying process in which the air is exhausted from the dryer with 0.04 lb. of water per pound of dry air at 115 deg. F. (point *M* in Fig. 3). In winter, when the humidity is below 0.005 lb. of water per pound of dry air, there will be 28.5 lb. of dry air required per pound of moisture, whereas in the summer with the humidity around 0.015 lb. of water per pound of dry air, 1 lb. of moisture would require 40 lb. of dry air. Speeding up the fan in order to put more air through the dryer will not suffice alone in securing the same capacity. We must also heat the air so that it will have the same drying potential. This we cannot always do if the material cannot stand the increase in temperature. In such cases, dehumidification of the intake air can advantageously be used.

Recently the suggestion was made to increase the thermal efficiency of

drying processes by employing a completely adiabatic cycle of evaporation and dehumidification, the concentration of the absorbent being accomplished in multiple-effect evaporators. With triple-effect evaporators for concentration, 2 lb. of water could be removed with 1 lb. of steam, which would better the thermal performance of any dryer by 250 to 300 per cent. Even assuming that the size of the plant would justify the installation of multiple-effect evaporators, a careful study is required before deciding on such a method. The required air horsepower may readily offset all the thermal savings over drying with heat if high drying temperatures can be used. Assuming that all difficulties which conceivably may be encountered in carrying out such a scheme are overcome, its application at least in connection with low temperature drying appears to have great merit.

# Underground Corrosion of Pipe

*The corrosion of pipe, tanks and other equipment buried beneath the ground near chemical plants is a common trouble. Identification of the causes of the corrosion are discussed and several effective remedies are offered*

UNDERGROUND CORROSION has been studied chiefly from the point of view of the operators of pipe lines and pipe networks because of the great extent and value of such installations. The operator of an industrial plant who has an underground corrosion problem can learn much through a study of the literature dealing with the corrosion of pipe lines. He will find, however, that his problem is somewhat different from that of the pipe-line operator both as to the relative importance of the possible causes of corrosion and as to the methods of mitigation which may be employed. This may be better understood by a brief review of the conditions which favor underground corrosion.

Without going back too far in a search for causes of corrosion, it may be stated that many conditions create differences in electrical potential between small areas on a buried metallic structure and other areas on that or an adjoining structure. There is a tendency for the establishment of an electrical equilibrium just as there is a tendency for water to reach an equilibrium.

In the establishment of the electrical equilibrium charged particles of the metal, cations, move out of the metal at a point of high potential and migrate toward a point of lower potential. This is the first step in the corrosion process. The seriousness of the corrosion depends on the number of migrating particles which leave the metal in a unit time and on the duration of the process. The latter depends largely upon what happens to the migrating particles, i.e.,

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upon secondary reactions at the anode or corroding area and at the cathode or receiving area. Incidentally, it should be mentioned that under most conditions the cathodic area is protected against corrosion. These differences of electrical potential may be set up by many differences in states or conditions of two points on the surface of the buried metal or in the soil solution which surrounds different parts of the metal. Specifically, differences of potential are created when one metal is connected to another, as when a brass service cock is screwed into an iron pipe or tank, when mill scale is removed from one point on the tank while it remains at another point, when a pipe passes from one type of soil to another, when the soil is not homogeneous as is the case with filled ground, when oxygen can reach one part of the surface of a metal more readily than some other part, or when a pipe picks up stray current at one point and discharges it at another.

The conditions under which differences of potential occur are so numerous that with a sufficiently sensitive instrument one is almost sure to find them wherever the apparatus is set up. The problem is therefore not the finding of possible causes of corrosion but the evaluation and interpretation of the differences of potential which are discovered for, while the difference of potential may indicate a possibility of corrosion, the amount of corrosion is affected by other factors. The almost universal practice of using a brass corporation cock for connecting water service

pipes to cast iron mains is a good example. The difference of potential between brass and iron or steel may be several tenths of a volt, but under most soil conditions the corrosion of the iron due to the brass cock, is distributed over such a large area as to be unimportant. In other cases the products of corrosion which collect on the brass or the iron reduce the corrosion to a negligible quantity. Under some conditions, however, the interconnection of brass and iron results in serious corrosion.

A brief discussion of a few of the cases of corrosion associated with industrial plants which have come to the attention of the writer may illustrate the variety of the corrosion problems which may arise in such plants. One plant consisted of a number of scattered buildings which were heated by a central steam-heating unit. The 1¼-inch special cast iron steam return lines began to fail within 18 months of their installation. There was no possibility of stray-current electrolysis, and tests of samples of the soil indicated that it was not corrosive. Long-distance diagnosis of such troubles is likely to be unreliable. However, since only the return lines corroded, it is apparent that the cause of the corrosion is associated with some difference in the conditions of the two lines.

A plausible explanation is that the return lines were not hot enough to keep the soil dry but were sufficiently hot to melt the snow which was above them during the winter and thus to establish a condition around parts of them of warm, wet earth which is particularly favorable to corrosion. This may have been augmented by the galvanic potential between the pipe in the wet earth and

\*Publication Approved by the Director of the National Bureau of Standards of the U. S. Department of Commerce.



that of the steam pipe surrounded by earth which was kept dry by the hotter pipe.

A large chemical plant was troubled by corrosion of its water main near a storage house. The ground was found to be contaminated by sulphates swept from the house or spilled when these materials were loaded or unloaded.

The fire lines of a refinery corroded rapidly. Inquiry developed the fact that the plant was located on the edge of a marsh, the pipes being imbedded in a muck soil occasionally flooded by brackish water. This is an ideal condition for corrosion.

A reinforced concrete packing house was built across the alley from a street railway power house. Within a few years the concrete began to spall from the reinforced beams and columns in large pieces. The presence of small currents was detected on the pipes within the building and on the reinforcing metal and suit was brought against the street railway company. Investigation disclosed the facts that salt was added to the concrete to keep it from freezing while the building was under construction and that the second floor of the

building was occupied by large vats used in the preparation of corned beef during which considerable water was spilled on the floor. Since the corrosion was not confined to places where the current might leave the reinforcing material for some other conductor, it is highly probable that the corrosion was attributable to the salt and the water.

The locating and remedying of corrosion troubles when they are serious can be done most economically by a specialist thoroughly familiar with such work. Fortunately there are in various parts of this country specialists in corrosion who are well qualified to locate and mitigate corrosion. An attempt to take care of the trouble by one with little experience may result in subsequent losses that may cost much more than the charges of a competent consulting engineer. Certainly, anything that can be written without specific knowledge of the local conditions must be of uncertain value to the plant superintendent who has a serious corrosion problem because of the large number of possible causes of corrosion. However, there are cases in which the employment of a consultant is impracticable or pro-

hibited by the management. The following suggestions are therefore offered for the use of those who must because of circumstances attempt to solve their own corrosion problems.

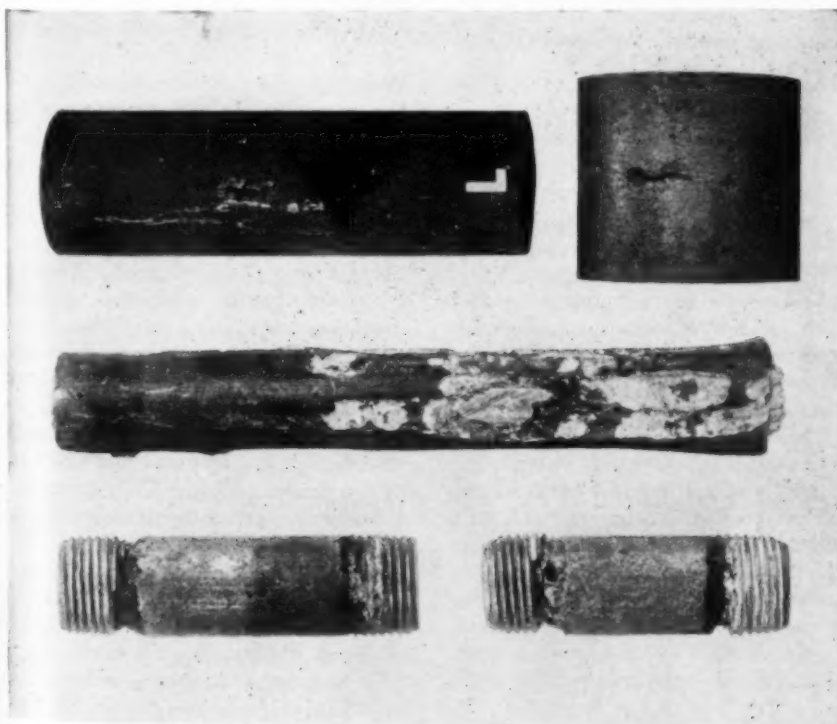
Obviously, the logical start in curing corrosion troubles is to locate the cause. The two causes which almost invariably are thought of first are: electrolysis and inferior materials, since these allow the owner to shift the responsibility from his own shoulders. Electrolysis has long been the standard alibi of the pipe manufacturer. The abandonment of the street railway system in many cities however has made the use of this overburdened explanation more difficult.

Stray-current electrolysis is in most cases easily recognized because it is confined to localities having direct-current systems with ground or grounded return circuits and because the currents can be recognized by their fluctuating nature. Usually electrolysis is associated with street railway systems but the writer recalls an instance of electrolysis which apparently was the result of using a ground return for a welding outfit in a shipyard.

The shape of the record obtained with a sensitive recording millivoltmeter connected in parallel with the corroded pipe, is often helpful in locating the source of the trouble. In any event if the instrument indicates a steady current or one which changes but slowly, it is improbable that stray currents caused the corrosion. Even if a fluctuating current is found, it must be proved that current leaves the pipe at the corroding area before it can be concluded that the current is the cause of the corrosion. The presence of current on a conductor does not cause it to corrode.

In the measurement of small currents it is necessary to take special precautions to avoid thermal e. m. f. and galvanic potentials. With proper care and instruments, however, it is possible to measure the current on each side of the suspected point of discharge and to measure the current in the earth adjacent to the corroding area. However, since current will be found to be leaving the corroding area in case of either galvanic corrosion or stray current electrolysis, and since current which merely flows across the pipe may occasionally be found in the earth, additional tests will be required to determine the nature and source of any observed current. The nature of these tests will depend on local conditions.

Top Left—Pit caused by slag inclusion. Top Right—Pit caused by difference of potential between steel pipe and lead coating. Center—Electrolytic corrosion of a lead cable sheath. Bottom—Corrosion of both ends of these ½-in. steel nipples indicates galvanic action between the couplings and nipples. Stray currents would corrode only end from which current flowed



To prove that the corrosion is the result of inferior material is in most cases even more difficult than to prove that corrosion was caused by stray currents. Microscopic examination of the metal will determine whether the structure is normal at the point examined, but the destruction of the metal at the point of failure is usually so nearly complete that if imperfect material existed evidence of it has been lost. In any event, only isolated cases of failure due to poor material should be expected and the cost of establishing the fact that imperfect material was used may easily exceed the cost of repairs.

#### Imperfections

Segregations in alloys, inclusions of slags or cinder and other imperfections set up potential differences which result in corrosion but there are many other sources of equal or greater potential differences. If the failing pipe was purchased from a reputable firm, the question of inferior material is scarcely worth considering. This conclusion is strengthened by the fact that under most soil conditions, the rates of corrosion of the commonly used pipe materials are controlled by soil conditions rather than by the composition or structure of the material. Only in cases where high-alloy steel or non-ferrous materials of relatively high price were specified is it likely to be profitable to inquire into the nature of the corroding pipe.

Most cases of underground corrosion are the result of corrosive soils or soil conditions. In general, soils which are poorly drained, soils which contain organic or other acids, and soils high in salts are corrosive. Serious corrosion seldom occurs in well drained soils having high electrical resistivity and high pH values. Many soils will be found to contain some characteristics tending to indicate that they are corrosive and other characteristics which suggest that they should be non-corrosive. Thus, a soil may have high resistivity and high acidity, or high pH value and high salt content.

A number of tests for soil corrosivity have been developed which are satisfactory for certain classes of soils or for the soils in a certain region. Few, if any, of them are entirely successful in identifying all corrosive soils. At best, a determination of the corrosivity of a soil will tell only whether or not the soil as a type is corrosive. It cannot be depended on

to tell whether corrosion of a particular spot was caused by the soil, although in many cases the indications of the test may be correct. This should be obvious from the fact that, even in an apparently uniform soil, serious corrosion is very localized. The corrosion is influenced by the contact between the pipe and the soil and by other factors in addition to the characteristics of the soil in which the corrosion occurred. In most cases of corrosion the investigation of the soil to determine whether it is corrosive is superfluous. The fact that the pipe corroded in the absence of conditions favorable to stray current electrolysis and that imperfections in the material are not obvious, are in themselves satisfactory evidence that the soil is corrosive.

When the first leak occurs in a pipe on the property of an industrial plant, it is advisable to examine pipes in a few other localities in the plant to determine whether or not the failure is accidental. If a number of leaks have occurred or if the pipe system is found to be corroded at a number of points, it is obvious that some action should be taken. As was said, if the corrosion is general and serious, the best course is to call in a consulting engineer. If this cannot be done, determine roughly whether stray currents are the probable cause. This is improbable, though not impossible, except in plants near street railway power plants and substations. If street railway current is found to enter the plant on one or two lines, insulating joints in the lines may stop the corrosion.

#### Cathodic Protection

Protection against electrolysis may also be secured by lowering the potential of the pipe networks at the plant by means of a superimposed current. This is known as cathodic protection and will be mentioned again.

Soil conditions are the most frequent causes of corrosion. In such cases two courses are open: the use of corrosion-resistant materials and the use of protective coatings.

The differences in the rates of corrosion of the commonly used pipe materials when exposed to the same soil are not great, and if one fails within a short time the others cannot be expected to last enough longer to provide a satisfactory solution to the corrosion problem. Alloys of iron high in nickel or in chromium and nickel are very resistant to most soils, as is iron containing more than 14

per cent of silicon. Copper and alloys containing a high percentage of copper are much more resistant to corrosion than the commonly used ferrous materials and will probably prove satisfactory except in cinder fills and soils high in sulphides. Lead pipe is very satisfactory in many corrosive soils, especially those containing sulphates, but lead pits badly in a few soils. Among the soils corroding lead is allis loam, a soil formed from a blue shale. The lead-coated pipe tested by the Bureau of Standards has not proved as generally satisfactory as galvanized pipe, perhaps because of the thinness of the lead coating.

The conditions under which galvanized pipe are unsatisfactory have not been fully determined but it has been shown that the weight and uniformity of the coating are important factors. Users of galvanized sheet and pipe should specify the weight of coating which they desire.

#### Protective Coatings

In many cases it may be more economical to protect a pipe network than to construct it of corrosion-resistant material. It is not difficult to protect parts of a pipe line temporarily. To provide permanent protection for all of a pipe line or network is much more difficult. There is evidence which strongly suggests that under some conditions an imperfect coating may accelerate pitting, although it reduces the total loss of metal.

The type of protection which should be used depends partly on whether or not the pipes can be removed from the ground. If the corroded pipe is of cast iron with bell and spigot joints, or if for any reason the pipe cannot be raised from the trench to a position where it can be cleaned and thoroughly dried, it is not advisable to apply a bituminous coating. It is possible to apply an asphalt emulsion to a moist pipe but tests with which the writer is familiar indicate that such coatings do not afford satisfactory protection against severely corrosive soils. Greases can also be applied to pipes that are not dry, if they are clean. Under wet soil conditions grease coatings have afforded very considerable protection to pipes over periods of approximately nine years. It is desirable that the grease be reinforced or shielded by a wrapper, preferably of asbestos felt. This of course requires the removal of the pipe from the trench. If the



pipe cannot be removed from the trench, probably the best protection will be afforded by removing the earth and corrosion products from all sides, blocking up the pipe by means of non-porous supports such as glass or vitrified clay and surrounding it by one or two inches of concrete or cement mortar. To do this, it is necessary first to surround the pipe by a form. The concrete should be poured on one side of the pipe only and tamped until it rises on the other side. This prevents the formation of voids on the under side of the pipe. Removable metal forms may be constructed but for small jobs forms built of cheap lumber which can be left in the trench may be cheaper.

The most extensively used coating for pipe lines is a bituminous enamel reinforced in very corrosive soils by a fabric. Hand application of these enamels is not altogether satisfactory, and machine application at the trench is not well adapted to small jobs. On this account, coatings applied at the rolling mill when the pipe is made are probably more suited to industrial plant installations. If these are used, it will be necessary to protect the joints after the pipe sections are connected.

It is difficult to secure a continuous coating free from pinholes, thin spots, and abrasions. Such defects sometimes result in accelerated corrosion by pitting. The evil effects of the defects may be overcome by applying cathodic protection to the line. This consists of connecting the negative side of a low-voltage source of power such as a battery charger to the pipe and the positive side to a suitably placed set of anodes such as carbon rods on junk pipe. If the coating is perfect no power will be consumed, but usually a small current will flow. Details of the installation of a system of cathodic protection cannot be given in a short paper, but the reader will have little difficulty in finding literature on this subject.

#### Remedies for Corrosion

Cathodic protection is equally suitable for preventing electrolytic corrosion of coated pipe lines. If the lines are bare, more current will be required and the probability of securing complete protection somewhat less.

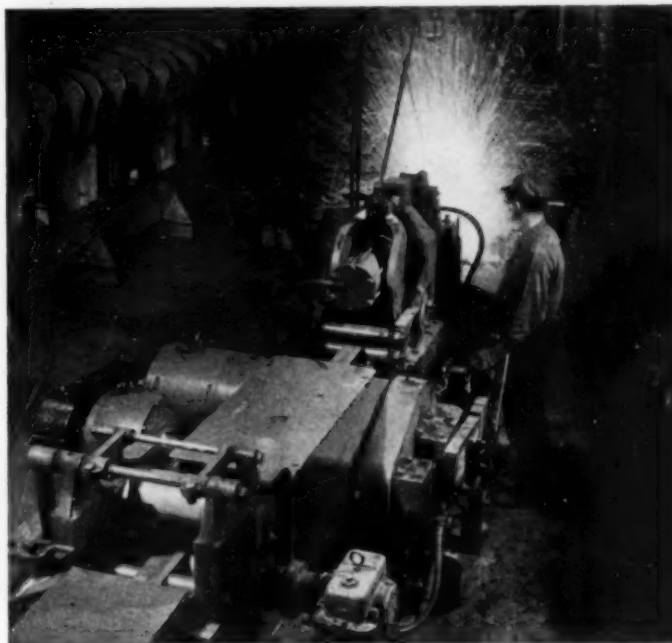
Since it has been observed that a protective carbonate film is sometimes formed in limestone soils, the addition of slaked lime, calcium hydroxide, to acid soils has been suggested.

It seems probable that this will be most effective in well aerated soils. Some poorly drained soils containing lime are quite corrosive. It is not uncommon to backfill trenches traversing filled ground with clear sand or clay. Either will of course prevent the corrosive filled-in material from contacting the pipe but the sand will allow any corrosive solutions to reach it. Some clay soils are quite corro-

sive. It is apparent, therefore, that these remedies should be used with discretion.

The mitigation of underground corrosion at an industrial plant is largely a matter of choosing the measure which best fits local conditions. Only the man on the job can make the proper selection. Some of the methods from which he may choose have been outlined above.

### PIPE FABRICATED BY CONTINUOUS PROCESS



PIPE is being fabricated by a continuous process that imparts to the product, known as C-W Butt weld pipe, certain advantages for its use in the chemical industries. The inside as well as the outside of every length of pipe is free of ridges and other obstructions caused by ordinary methods of welding that would tend to interfere with the flow of liquids and gases through the pipe lines. The joints are said to result in a stronger, more durable pipe, features of increasing importance. The automatic welding technique gives a more uniform weld than usually encountered.

The new method developed by the engineering department of Spang Chalfant, Inc., is adaptable to low carbon and copper steel pipe in sizes from  $\frac{1}{2}$  to 3 in. inside diameter.

The first unit in use at the company's mill at Etna (Pittsburgh), Pa., has a capacity of 6,000 tons per

month. The small sizes of pipe are made at the rate of about 300 ft. per min., and 2- and 3-in. at 200 and 100 ft., respectively.

The method consists of flash welding the end of the skelp on one reel to the beginning of the next reel. While the weld is white hot it passes through the trimmer where it is dressed off leaving smooth surfaces top and bottom. The continuous skelp passes through the gas-fired, 143-ft. heating furnace at a uniform rate of speed. Heat resistant alloy rolls and water-cooled skids prevent the skelp contacting the furnace lining and becoming contaminated by the slag during its journey. As the skelp leaves the furnace the two edges are brought together by forming rolls and welded. The continuous pipe is cut into 20-ft. lengths, the scale removed, ends threaded, etc. Each length of pipe is inspected and tested.



# Materials-Balances Reduce Costs

*In process industry plants materials-balances are essential for detecting many sources of waste. The present article explains, with a number of examples, various types of materials-balances, how to install them, and their effects on other departments.*

OVER FOUR BILLION DOLLARS is now being spent annually by process industries for raw materials.<sup>1</sup> This sum is equivalent to more than half the value of the finished products. For example, the cost of materials accounts for 60 per cent of the selling price of fertilizers, 50 per cent in the case of sulfuric acid, and 45 per cent for heavy chemicals. In the more elaborate synthesis of such complex molecules as dye-stuffs, the purchase of starting products requires about 20 per cent of the sales dollar. Conservation of raw materials is therefore of special significance in chemical manufacturing because they represent a relatively high proportion of total costs.

There has gradually been developing in industry an appreciation of the fact that classical materials accounting methods, involving periodic checks of inventories and purchases against conventional records of quantities charged into operations, do not make optimum use of data available in carefully controlled processing. Even though the amounts of starting materials are correlated with the yield of products, this over-all type of accounting ordinarily leaves many gaps in the quantitative knowledge of what really becomes of the components at the successive process steps.

Through the increased use of weighing and metering equipment and through the introduction of laboratory control of process, the chemical industries have provided the means for a much more comprehensive and accurate system of materials accounting. In many plants there exists in

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inchoate form a mass of data on quantities and compositions of raw materials, intermediates, wastes, products, and byproducts which can be integrated into an illuminating statement of operations by intelligent co-operation between accounting department, plant management, and control laboratory. There has been little published discussion,<sup>2</sup> either in the chemical engineering or the accounting literature, of this hybrid process of combining actual weights of materials with analytical figures through a systematic accounting procedure to give a step-wise break-down of process in terms of major components. It has not even been accorded the recognition of formal nomenclature, for it is known by several terms: chemical-balance, chemical bookkeeping, materials-balance, materials control, technical control, and weight-balance.

Materials-balance accounting is peculiarly applicable to chemical operations, because in these types of manufacture the composition of the matter undergoing change is more significant than grosser differences in physical structure or appearance. The procedure consists of the routine checking of amounts of one or more major raw materials or selected components throughout the process of manufacture. From the weight figures, either direct or derived, of the starting products, mixtures, solutions, or compounds, the net weight of the component at each process step is obtained through the use of analytical

results reported by the laboratory. To a considerable extent these data represent the normal routine of checking purchases, controlling operations, and maintaining quality in finished products. All significant by-products are similarly weighed and analyzed. Measurement and analysis begin as the raw material is received, continue throughout the operation at suitable stages, and do not cease until the finished products are ready for shipment.

The accounting involves balancing the total weights of components going into process during the reporting period against the weights of the same components in finished products, byproducts, and known wastes during the same period. The difference between totals represents unaccounted-for loss, and should be so shown in operating statements. Usually, when the balancing system is first introduced, the discrepancies will be astonishingly high.

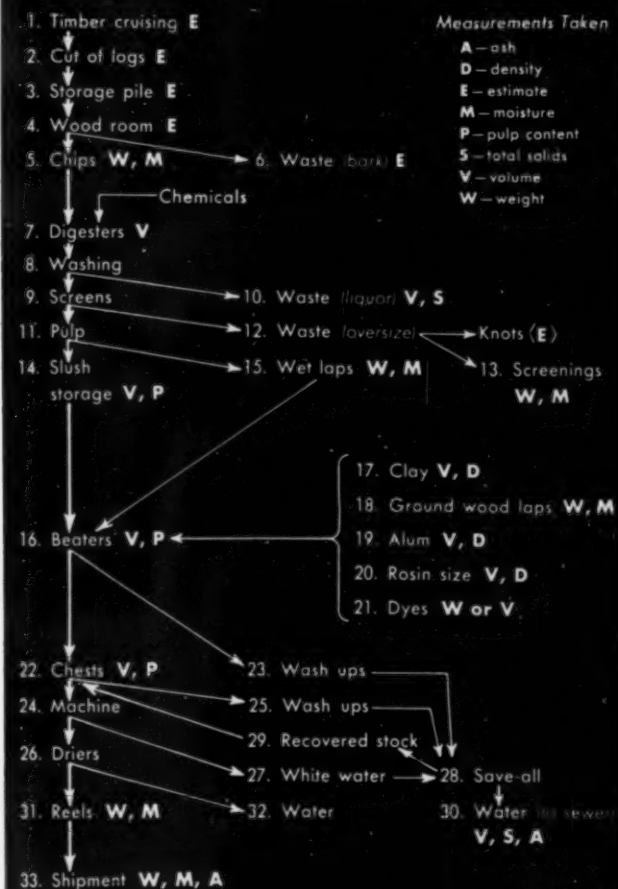
## Types of Materials-Balances

For purposes of discussion it is helpful to classify materials-balance accounting systems arbitrarily into four types, corresponding to the complexity of the procedures used.

*The Simple Weight-Balance*—In controlling manufacturing processes in which the raw materials go through various separating, classifying, refining, shaping and fabricating processes without essential change in chemical composition, materials-balance accounting can be carried out satisfactorily solely on the basis of weights. Such a procedure is applicable to petroleum refining, textile manufacturing, metal stamping<sup>3</sup> and casting, coal-tar distillation, meat packing, etc.

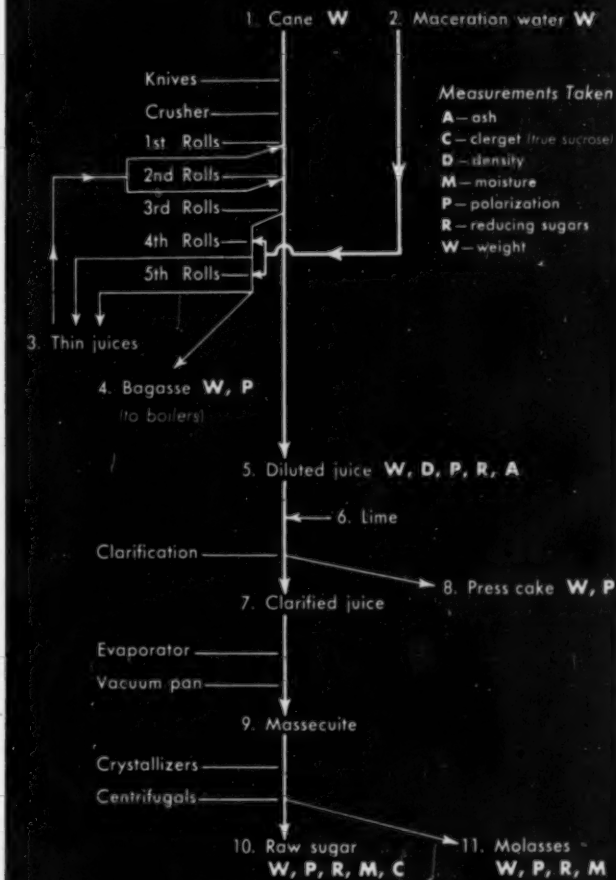
This article is based on a paper presented at the White Sulphur Springs meeting of the American Institute of Chemical Engineers, May 11, 1938.

## Paper Manufacture



1. Estimate of board feet in standing timber.
2. Estimate of board feet or cords.
3. Estimate or measurement (in cords).
4. Estimate of charge in digesters; moisture content determined to calculate weight on dry basis for computing balance.
5. Weight of chips in digesters; often used with an empirical factor as an alternative to weighing the chips.
6. Volume and density of waste liquor used to compute weight of solids removed from chips.
7. Weight of pulp charge to beater calculated from volume and pulp content.
8. Clay utilization; checked on one hand against car weights corrected for moisture, and, on the other, against ash in finished paper (33) plus ash from save-all (30).
9. Utilization of ground wood laps, checked against car weights corrected for moisture.
10. Alum consumption, based on analysis of shipments.
11. Rosin size, checked against car weights; a balance is difficult to set up because of rosin introduced by chips.
12. Weight of paper, calculated from basis weight and machine speed corrected for trim and moisture.

## Raw Sugar Manufacture



1. Cane coming into the factory in cars or carts is weighed on track scales or wagon scales.
2. Maceration water is weighed in tank scales (or volume is measured if scales are not available).
3. Thin juices are returned and sprayed on the cane after the first and second sets of rolls.
4. Weight of bagasse equals weight of cane plus weight of maceration water minus weight of dilute juice. Sucrose lost in bagasse equals weight of bagasse times sucrose content.
5. Diluted juice is weighed in tank scales. Composite samples are analyzed for density, polarization, reducing sugars, ash, and organic non-sugars (by difference).
6. Press cake or mud removed from the juice is weighed, sucrose is determined, and the loss of sucrose is calculated.
7. Raw sugar from centrifugals is weighed on automatic scales and sampled.
8. Sugar is analyzed for true sucrose, polarization, reducing sugars, ash, moisture, and organic non-sugars (by difference).
9. Final molasses is either weighed or measured and is analyzed for the same constituents as the raw sugar.

Fig. 1, Left—This flow diagram of a paper manufacturing plant illustrates the extensive use of the corrected weight-balance  
 Fig. 2, Right—The chemical-balance based on sucrose content has been used in the sugar industry for a great number of years

The spinning of cotton yarn from baled cotton may be cited as an example of the use of a simple weight-balance. The lint passes through a succession of operations in its evolution from random fibers through cotton lap, card sliver, combed sliver, roving and ply yarn, into warps of ply yarn. In good mill practice the following types of wastes are collected separately, weighed, and dis-

posed of as profitably as possible: bagging and ties, bagging scrap, motes, card strip, comber waste, roving waste, thread waste, sweepings, fly wastes, and handling wastes. There may also be a loss in weight through products of combustion from the gassing operation. The finished warps of yarn are weighed, but are sold on theoretical weight, which is based on count, yardage, and num-

ber of ends. From bale weights to yarn plus wastes a monthly operating balance can be obtained which shows a low percentage discrepancy.

**The Corrected Weight-Balance—**  
 This type of control represents the introductory step in applying laboratory data to process accounting. Net weights of the essential components are obtained by applying corrections for incidental substances or impuri-

ties. The determinations involved are usually rather simple in character, such as moisture or specific gravity. For example, in the manufacture of industrial alcohol a materials-balance can be set up on the basis of the sugar content of the molasses and the alcohol percentages at successive process stages. In addition to the relative simplicity of the measurements, legal requirements have led to the use of this method of manufacturing control.

A schematic outline of materials-balance control in the manufacture of paper is shown in Fig. 1. Three balances are illustrated in this example, viz., steps 1 to 5, steps 5 to 14 and 15, and steps 16 to 33, the first two being very approximate but nevertheless helpful in planning operations. It is of course not to be expected that an estimate of the yield of chips from standing timber (cruised probably at least three years before the logs reach the wood room) will show much accuracy; a discrepancy of 10 per cent is perhaps a low figure. From the weight of chips a balance can be struck against the yield of pulp or wet laps; the uncertainty should be within 10 per cent. Paper ready for shipment is balanced against corrected pulp weight at the beater, and should check within 2 to 5 per cent.

It will be noted that in the later steps of this process separate chemical-balances are used to account for the quantities of added materials. In this connection, Rodowski and Knowles<sup>4</sup> have worked out a balance for a continuous recausticizing system which was applied to the study of soda losses in this operation. Knowles<sup>5</sup> subsequently developed a procedure for routine control, with suggestions on sampling and analytical methods, and graphs to facilitate computation.

*The Chemical-Balance*—The materials-balance was adopted many years ago in the manufacture and refining of sugar, both as a means of accounting for materials and as a control of operations, and has become standard practice for both cane and beet sugar.<sup>6</sup> Its use in this industry probably antedates any other extensive application of the procedure. The main balance is on sucrose. The ease and accuracy of determination of this compound by means of the polariscope have been important factors in encouraging the use of chemical accounting.

A materials-balance flow sheet of the manufacture of raw sugar from sugarcane is given in Fig. 2. Practically all operations in that process are shown, with the exception of the boiling back of syrup and molasses. Some of the control steps indicated do not strictly pertain to the materials-balance, but are valuable as a measure of milling efficiency. A very close check is maintained on sugar content throughout the process.

In the following paragraphs examples of chemical-balances in several other types of manufacture are cited. It is well to point out that, although in any given process the principles of the balance may be the same, each individual plant will usually require a system modified to suit its particular methods of operation and control. It is suggested that the subject of materials-balance accounting is especially suitable for joint consideration by the accounting and technical groups of trade associations.

#### Other Examples

In recent years materials-balance accounting has been developed for milk plant operation.<sup>7</sup> Attention has naturally centered on butterfat, since it is the most valuable constituent, and also is easily determined by the Babcock test. The total fat in receipts of fluid milk and cream is balanced against total fat content of all products plus known wastes; the difference, which should not exceed 2 per cent, represents unaccounted-for losses. In plants receiving milk direct from farmers, the balance will usually be computed for 10 day periods, because payments to the producers are made on this basis.

An outline of a system for controlling materials costs in coal tar fractionation has been given by Staniforth.<sup>8</sup>

In discussing the cost factors in the manufacture of nitric acid, Potter<sup>9</sup> stressed the importance of eliminating sources of waste as revealed through study of process data. During the period 1916-18 in a group of nitric acid plants in England the average efficiency of recovery of nitrogen was raised from 87.6 to 93.5 per cent through effective use of materials-balance data. From an analysis of figures from several plants manufacturing trinitrotoluene, Potter also suggests the following method for improving efficiency of operation: A balance-sheet is constructed on the basis of nitrogen, showing on one

side the total quantity entering the factory, and on the other the quantity dispatched as finished product, together with the quantities in the respective byproducts and sources of loss. This is then set out on a percentage basis and reduced to graph form for comparison with preceding periods and with other plants.

#### *The Indirect Chemical-Balance*—

In the cases in which there has been extensive application of chemical-balance systems, the ease of determination of some component has been an important factor. Some operations in which a need for accurate control was recognized have been followed by adding a foreign material, preferably inert, which could be assayed readily. An application of this type of balance has been worked out for determining the air leakage from closed systems. This procedure has been made use of in cases involving the vaporization of volatile solvents in a solvent recovery apparatus, the air from the solvent recovery unit being recirculated through the fabricating unit. Processes susceptible to this type of treatment include the manufacture of artificial leather, the lacquer coating of papers or fabrics, the casting of film support, etc.

Information in regard to a practical application of the indirect balance has been made available through the courtesy of the Eastman Kodak Co. The method for determining leakage is based on the fact that if an inert material, i.e., a substance not produced by the manufacturing operation and not absorbed by it, is introduced into the system, the decrease in concentration of the foreign material can be expressed mathematically as a simple first order differential equation. If  $x$  represents the concentration of the substance introduced,  $dx/dt = Kx$ . If the definite integral is obtained, the following expression is reached:

$$K = \frac{\ln x - \ln x_1}{t - t_1}$$

If a material is introduced whose concentration can be easily determined at frequent time intervals, it is necessary only to plot  $x$  against  $t$  on semi-logarithmic paper in order to obtain the rate of decrease of the constituent  $x$  with time, the rate being the slope of the straight line.

Since the rate of decrease of the constituent  $x$ —which has become thoroughly mixed with the air in the system by the time measurements are begun—is proportional to the leak-



age, it is necessary to know only the total volume of the system, i. e., coating machine, recovery system, interconnecting duct work, fans, etc., to be able to calculate the air leakage.

When the vehicle for solvent removal is air, it is very convenient to introduce small amounts of some material with an extremely high thermal conductivity, such as helium or hydrogen, and then to follow the decrease in its concentration by periodic determination of the thermal conductivity of the air. If hydrogen is used, proper precaution should be taken to eliminate the possibility of accidentally reaching an explosive mixture.

Another case of indirect chemical-balance is furnished by the work of Mangelsdorf, Sowers, and Deutser<sup>10</sup>, who for test purposes applied the dilution method of measurement for determining rate of flow of internal recirculating hot-oil streams on commercial cracking units and distillation equipment. Commercial naphtheneic acid was employed as a diluent because its concentration may be determined accurately, it is sufficiently stable, it is non-corrosive, and its cost is moderate. Tests on a commercial cracking unit indicated that charge rates determined by this procedure checked within a per cent the rates determined by tank gagings.

#### Installation of a Materials-Balance

Perhaps the prime requirement for the successful introduction of materials-balance accounting is a common sense point of view of the significance of the results and the limitations of the data. Close cooperation and sympathy are required from manufacturing department, laboratory, and accounting department. The working out of the details of procedure partakes of the nature of research and development, and the introductory period of routine use needs close supervision. It is the writers' opinion that best progress will be made if responsibility for the evolution of the method is placed on the chemical engineer, for he is in a preferred position to coordinate the three component activities. It should be borne in mind that much of the background of a materials-balance is already in existence in a well operated plant, and, further, that the savings that may be effected in a series of operations are cumulative. The over-all improvement may therefore justify weight and analytical control to an extent heretofore impractical.

The first step in setting up materials-balance accounting is to select the component or material that is to be followed through process. This balance item should preferably be present in important quantities; should, if feasible, represent an item whose cost is a significant expense factor; and—especially for more thorough accounting—should be determinable with adequate ease, accuracy, and rapidity by chemical analysis or physical measurement.

In inorganic technology there is usually at least one constituent that may be determined with relative ease. The situation is similar for organic compounds containing a characteristic element or grouping. For example, many types of food processing are susceptible to workable materials-balances on the basis of nitrogen. Where such a specific balance item is absent, the situation becomes much more complicated. A balance on the basis of the element carbon may prove feasible in some cases.

A materials-balance system should preferably cover the entire manufacturing procedure. But it can, of course, be restricted to one or a few operations. In setting up a system it is frequently desirable to limit its scope to certain steps, and then gradually extend it throughout the plant. The balance item may if necessary be varied, with proper correlation, from one operation to another.

The period of time to be covered by each balance depends upon the practical requirements of the particular type of manufacture. In general, the shorter the period, within reason, the more effective the balance will be as a control procedure. A daily summation of data is likely to prove most satisfactory, if conditions permit the use of such a short period.

Finally, it should be pointed out that a periodic materials-balance may be valuable as a method of surveying the efficiency of operations in plants which are not prepared to adopt a plan of routine use.

*Data on Weights*—In the plant, a careful materials-balance can rarely be instituted without necessitating a greater number of measurements, either of weights or volumes. It is surprising, however, how much more information can be obtained, without increase in labor costs, by laying out a careful routine for taking data, particularly where it is possible to mechanize the measuring operations to some extent. A point that is fre-

quently overlooked is the necessity for obtaining reliable values for the weights of finished product in containers; even though it be the policy to overfill the package, the actual figures should be used in the calculations. The percentage error in all data will generally be a source of concern, for it is difficult to achieve a high degree of accuracy with current plant facilities. The operation of a materials-balance, however, does not require accuracy greater than that obtainable under practical conditions.

*Laboratory Data*—The development of materials-balance accounting will usually require some shift in emphasis of the laboratory program, but this frequently will prove to be of advantage in laboratory administration. The taking of representative samples presents all the usual difficulties. The procedures adopted will necessarily be those that give maximum accuracy within the limits of practicality. Incidentally, the materials-balance should give a check on the preciseness of the sampling technique being used.

The available analytical procedures should be considered on the basis of speed and accuracy. Extreme exactness is usually not required. For example, the Babcock test for butterfat, which is read only to 0.05 per cent, proves adequate for routine practical use, although the average fat test in milk is only about 3.5 per cent. If laboratory results are obtained with great accuracy, while the weights are roughly estimated, or vice versa, the plan becomes top-heavy.

*Accounting Procedures*—The interest of the accounting department should be enlisted at an early stage in the introduction of the balance system. Almost always the existing accounting procedure has the right of way and the new method should be tied into it wherever possible. Usually it is necessary to carry the two systems along side by side for a time; in fact, this is an advantage, for it enables one to obtain satisfactory factors for comparing future figures with records of past years.

The extent to which a materials-balance will displace existing accounting procedures depends considerably upon the nature of the operation and particularly upon the extent to which the balance has been worked out. In straight-line manufacture involving one major raw material and the development of several

products from it, a balance on the chief ingredient or component is likely to provide a sufficiently detailed picture. With a multiplicity of important raw materials, however, several balances may be required.

#### Advantages of Materials-Balance

Use of a properly organized system of materials-balance accounting brings about greater effectiveness in all departments of a business. Benefits are especially noteworthy in production, as a result of the more exact knowledge that is gained concerning details of processing. Yields are improved through the elimination or diminution of wastes and losses. The accumulation of comparable data is of great assistance in the choice of alternative operating procedures and raw materials. Increased care on the part of the operators is ensured through their appreciation of the cumulative losses caused by small wastes. Improved quality of products—which is, of course, of vital significance in sales activities—is a

major advantage of the more rigorous control effected by the materials-balance.

Functions of the accounting department come closer to the ideal of representing accurately the course of manufacture and become more truly integrated with the entire company.

The purchasing department profits from more exact knowledge of the performance in a given process of raw materials from different sources. The control laboratory, instead of serving as a passive referee of raw material and product quality, makes a more direct contribution to the operating affairs of the company.

Management secures greater co-operation among the various departments and more significant data on which to base decisions. This latter point is of particular value in changing markets when the plant is able to produce a variety of products with the same labor and equipment.

Information and suggestions from several sources, particularly from Messrs. F. W. Adams and G. P. Meade, are gratefully acknowledged.

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## New Product From Pickling Liquor

DISPOSITION of something like 2,000 tons per day of pickling liquor has long been a problem to steel industry executives. Various state laws already enacted and the proposed federal law against stream pollution have brought this matter to a crucial point.

Pickling liquor, since it is made by the action of sulphuric acid upon steel, contains for the most part a saturated solution of ferrous sulphate. However, several per cent of free sulphuric acid is also present in most cases, which makes the liquor a nuisance because it tends to corrode metals in addition to making water unsuitable for sustaining fish life.

Several methods of disposal have been tried. The pickling liquor has been neutralized with lime and discharged into the stream, but hydrolysis slowly returns it to the corrosive stage. Conversion to copperas has been effected in at least one mill, but the entire world's consumption of copperas could be supplied in a few days with the enormous amount of pickling liquor used.

Recently, a process was developed by H. Seymour Colton, Cleveland, whereby waste pickling liquor can

be transformed into a building material, said to have remarkable insulating properties. The process, now controlled by the Allied Development Corp., also of Cleveland, is relatively simple and inexpensive and the amount of capital required for equipment is small.

The new material is largely a coprecipitated iron oxide and calcium sulphate, and has been named Ferron. One of the interesting things about it is that during its manufacture it goes through a stage where it is perfectly plastic and can be molded into any desirable shape, later setting to a hard, rigid mass by a combined process of drying and oxidation. After drying and setting, the new material is tan in color and extremely porous.

Ferron resembles wood in many respects, but it is said to be fireproof, termite-proof, and warp-proof. It is somewhat like plaster but has 550 per cent the insulating value of plaster-made products and also will stand a much higher temperature without losing its strength. It is similar to fired clayware such as brick, except that it weighs only one-third as much and will cut, saw and machine perfectly,

according to the inventor. An inch-thick slab of the new material is said to have an insulating effect equal to as much as 15 in. of brickwork.

Several uses have already been developed for Ferron. One of them is wallboard. It can, it is said, be made into sheets of any desired size and thickness which will bear nailing, and have five times the insulating value of gypsum lath.

As a pipe-covering, Ferron has about the same insulating value as 85 per cent magnesia but is much stronger and will insulate at a higher temperature (900 deg. F. instead of 600 deg. F.) without losing its strength, according to Mr. Colton.

Ferron presents a new material for chemical purposes. It removes hydrogen sulphide and other sulphur compounds from gases and liquids. Silver kept in boxes or on slabs of Ferron will not tarnish. It is an ideal filter medium for many operations. Tests now being conducted indicate that Ferron can be used agriculturally as a soil conditioner and secondary fertilizer.

The Sharon Steel Corp. was the first of the steel companies to obtain a license for the process and is now constructing a plant at its mill in Sharon, Pa., which when completed will produce normally 25 tons per day of Ferron.



## Readers'

# VIEWS and COMMENTS

### Public Relations for Business

To the Editor of Chem & Met.:

Sir:—For several years now I have watched strong and yet stronger editorials in the technical and business magazines calling for a return to sanity, horse-sense, basic fundamentals and plain unadorned business and personal honesty. All these have been food for my starving soul. They have been saying things that have needed saying, but the ears they reach are those already of the same belief and creed.

What we need is converts from the ranks of our legislators, both labor and business. How can we reach them? Two ways occur to me:

*First*—Go to the editors of the daily newspapers and of the popular weeklies, such as *Colliers* and *Saturday Evening Post*, and collaborate with them in presenting the case for the business and technical world; use the Sunday feature sections for articles on the state of the nation, illustrated profusely with charts and graphs clearly emphasizing and analyzing the effects of tariffs, trade treaties, subsidies, transportation costs, strikes, wages and hours. In other words, spread the news and you will find that a goodly number of our people still nourish that good old traditional American horse-sense.

*Second*—Have business conduct public educational forums to inform labor and the local communities of the state of business, effects of competition, regional inequalities in wages and hours, transportation costs, shipping subsidies, or lack of them, etc. A restoration of confidence between business and labor and the long-suffering general public is so very important that the biggest and best brains in our nation should be hammering away at it.

As a long range program, let us examine, watch and guide our public schools. You may remember the recent and very serious indictment of our high schools by the educational committee of the American Chemical Society. Also, you may have heard some of the following: "Parents are back numbers;" or "the home has broken down—therefore the school must take over;" or "our modern streamlined education is so advanced that Dad can no longer super-

vise and correct Son's homework." It strikes me that the school boards and teachers have been bitten by the same bug that has bitten the Hitlers and Mussolinis—an urge for personal power, and it is past time for them to be reminded that they are still public servants.

It has been too easy in this country to "let George do it." We, as a nation, have been too prone to turn things over to our elected officials and then forget about them while going our own ways.

WILLIAM C. MCINDOE  
Industrial Chemical Consultant  
Portland, Ore.

#### CATALYSIS COSTS REPLY

To the Editor of Chem & Met.:

Sir:—I have read Dr. Andrew M. Fairlie's discussion in the July *Chem. & Met.* of my paper on "Catalysis Costs" and am pleased to see this comment from so competent a source.

Dr. Fairlie states that the paper assumes that the rate of catalyst depreciation is constant and does not take into consideration any naturally occurring irregular variations in this rate. It was found expedient to assume a constant catalyst depreciation rate in both of the examples shown. This assumption, however, is not essential for the successful application of the methods for determining catalyst life.

The data given in Table I and Fig. 2 of the article are operating and cost data from an actual catalyst. Examination of the values for chemical yield in Table I will show that the catalyst depreciation rate was quite irregular, a fact which seems to have been overlooked by Dr. Fairlie. The life of this catalyst was determined with sufficient accuracy by the proposed methods.

General rules for determining catalyst life, which apply when considerable irregularities in catalyst depreciation rate occur, are given in greater detail in the original paper. The underlying principle for catalysts whose activity is declining constantly but not necessarily at a constant rate is that the economic life has been found at approximately the point where the cumulative losses equal the initial cost. After all, apart from mathe-

matical equations, this is common sense, since when the losses exceed the original cost of the catalyst, it is good economics to discard it. When a catalyst depreciates to a certain point, however, and depreciation then ceases, the question of when minimum costs are reached is determinable only by examining the trend of total catalyst cost.

Concerning Dr. Fairlie's statement, "Where changes affecting the depreciation rate are unpredictable, it would be impossible to calculate accurately the life of the catalyst," we are at a loss as to the sense in which this is to be interpreted. If by "unpredictability" is meant irregular variation of the depreciation rate per pound of product, the objection has been answered above. On the other hand, if Dr. Fairlie means that catalyst life cannot be calculated in advance without knowledge of the depreciation rate, we agree with him.

In this respect the article also states, "After the efficiency characteristics of a catalyst are known, its life can be determined and renewal dates anticipated. When a catalyst of an untried type is being used, it is not possible to predict its life exactly. The most practical procedure in such a case is to plot the curve for cumulative losses and investment cost (this is an error; should have been initial cost) at the end of each production period. These will begin to approach equality some time before they intersect."

In commenting on the section "Comparison of Catalysts," Dr. Fairlie has properly assumed that the catalysts compared, except for certain details, might be vanadium and platinum sulphuric acid catalysts. He has made an excellent explanation of how the handicap of lower burden capacity, as in the case of the former, may be overcome by increasing the size of the plant equipment and amount of lower strength gas passing through the plant. However, in the article it was indicated that the catalysts compared were intended for installation in an existing plant, thus precluding an increase in the size of the plant.

HERMANN W. MAHR  
E. I. du Pont de Nemours & Co., Inc.  
Wilmington, Del.



# Chemical Engineer's BOOKSHELF

## Latex and Lubricants

### LATEX MARCHES ON

THE CHEMISTRY AND TECHNOLOGY OF RUBBER LATEX. By *C. Falconer Flint*. Published by D. Van Nostrand Company, Inc., New York City. 715 pages. Price, \$14.

Reviewed by *Harry L. Fisher*  
MUCH scientific as well as technical work had to be done before latex could be used commercially, but once the groundwork was laid expansion was rapid. Ten years ago only about 3,000 long tons of rubber was exported in the form of latex, whereas last year about 28,000 tons was exported. Under such conditions of fast growth the difficulty of keeping abreast of the large amount of patent and technical literature is great, and a good book on the subject is therefore of real service not only to the technical man but also to the manufacturer and others who are interested in the use of this unusual material.

The present book was begun as a translation of Georges Genin's "Chemie et Technologie du Latex de Caoutchouc," which was published in 1934. The translation is complete and has been augmented by much new material which increases the size by about two-thirds. Besides extensive additions to the text, the new material includes two completely new chapters, some new diagrams and photographs, and a welcome author and subject index. The author was formerly a member of the staff of The Rubber Research Institute of Malaya and is now of the technical staff of Imperial Chemical Industries engaged in investigations of latex, and is, therefore, in the words of Col. B. J. Eaton, "eminently qualified to be the author of such a publication."

The following list of chapter headings indicates the wide range of material covered: Historical; The Source of Rubber Latex; Composition and Properties of Latex; Coagulation of Latex and Preparation of Rubber; The Preservation, Shipping, and Concentration of Latex; The Compounding and Vulcanization of Rubber by Latex Processes; Manufacture of Dipped Goods from Latex; Electrodeposition of Rubber in Latex; Impregnation of Fibres and Fabrics; Latex in the Textile Industry; Various Applica-

tions of Rubber Latex; Physical Testing of Latex Rubber; and Artificial Dispersions of Rubber.

The book has a large amount of very good and useful information on both the theoretical and practical aspects of latex. It is natural that the author cannot discuss every subject critically and equally well, but in this case he has kept a good balance and written a good treatise. A careful reading and study of the book should give one a liberal education in latex and its applications.

### LUBRICANT REFINING

MODERN METHODS OF REFINING LUBRICATING OIL. By *Vladimir A. Kalichevsky*. A.C.S. Monograph No. 76. Published by Reinhold Publishing Corp., New York City. 235 pages. Price, \$6.

Reviewed by *Donald L. Katz*  
DESCRIPTION of several modern processes for dewaxing, deasphaltizing and solvent refining of lubricating oils is contained in this volume along with a discussion of addition agents to lubricants. Primary emphasis is placed on present or proposed commercial installations.

The book fulfills the purpose of an A.C.S. Monograph by systematizing and classifying numerous processes for refining lubricants, by compiling the scientific and patent literature on the subject, and by presenting a readable description of the scientific and commercial development for persons not especially engaged in the refining of lubricants.

The author begins with a discussion of the properties of refined oils and continues with trends from past to present methods of obtaining lubricants from residuum or intermediate refinery products.

Dewaxing methods utilizing filter aids and solvents such as propane are described, followed by a section on the deoiling of waxes. Asphaltic substances are classified as carboids, carpenes, asphaltenes, and resins. Older methods of removing these substances from lubricants are discussed prior to the section on deasphaltizing with solvents, propane and aliphatic alcohols. The general principles of solvent refining precede large sections devoted to liquid sulphur diox-

ide, chlorex, furfural, phenol, nitrobenzene, aniline, crotonaldehyde, duo-sol and other solvent refining processes. The remainder of the book gives the theory, sources, and uses of pour point depressants, viscosity index improvers, oiliness carriers, oxidation inhibitors and fluorescence improvers.

The book is void of all engineering implication, such as flow sheets, specific examples, operation, capacity and sizes of equipment used, and solvent requirements. Qualitative descriptions of operating temperatures, solvent ratios and yields may be obtained from the discussions.

The excellent manner in which the author carries out the purpose of the book makes it valuable to the research man because of the classification and numerous references given, to the executive in that he may acquaint himself with present and past art, and to the student and salesman for bringing a brief up-to-date picture of modern lubricants and their manufacture.

### TANTALUM AND COLUMBIUM

THE ANALYTICAL CHEMISTRY OF TANTALUM AND NIOBIUM. By *W. R. Schoeller*. Published by Chapman & Hall, Ltd., London, W.C.2. 198 pages. Price, \$5.50.

Reviewed by *R. Winchester*  
THE RAPIDLY increasing importance of the earth acids makes this book an especially timely one. The book is based upon original researches by Dr. W. R. Schoeller and his associates and is essentially a reorganization of his publications in *The Analyst*.

It presents a number of important contributions to the analytical chemistry of tantalum and columbium and is divided into three parts. Part 1 discusses minerals and mineral analysis. Part 2 is devoted to quantitative separation methods, while Part 3 contains an excellent summary of the applications of tannin to gravimetric analysis. Particular attention is called to Chapter II, "Tantalum and Niobium Compounds of Analytical Importance" and Chapter XVI, "The Literature on Earth Acid Analysis."

The analytical chemistry of tantalum

and columbium and their mineral associates is covered as completely as is possible at the present date. Of particular importance is the discussion of the salicylic acid method for the separation of tantalum and columbium from titanium. Also discussed in detail is the separation of tungsten from earth acids, tantalum from columbium, and other separations not readily available in other references. The discussions are accompanied by detailed procedures and data showing probable accuracy and precision.

This book is highly recommended as a reference text in any laboratory concerned with the qualitative or quantitative analysis of tantalum and columbium materials.

### THERMODYNAMICS OF MATTER

STATISTICAL PHYSICS. By *L. Landau and E. Lifshitz*. English translation by *D. Schoenberg*. Published by the Oxford University Press, London and New York. 232 pages. Price, \$6.

Reviewed by *Charles E. Morrell*

THIS BOOK presents in a concise and systematic manner the relationships between the thermodynamic properties of aggregate matter and the classical statistical properties of the constituent particles. Although not mathematically rigorous in its treatment, the book does, nevertheless, present the material in such a manner that the physical and chemical facts and assumptions upon which the derivations are based are fixed clearly in the reader's mind. For this reason as well as for the fact that no recent English book covers this field, this book should be of considerable interest to all who desire a simplified introduction to the manner of approach and the limitations of the Gibbs' statistical method for deriving the macroscopic properties of matter.

After presenting the statistical bases of the thermodynamic functions, the authors proceed to a discussion of perfect and imperfect gases, liquids, solutions and solids. Separate chapters are devoted to discussions of the concept of the chemical potential, the conditions of equilibrium between phases, the properties of solutions, the equilibrium conditions in chemical reactions, the phenomena of anisotropy and transition points, and the relation of surface forces to the properties of liquids and solids.

ADVERTISING AND SELLING THROUGH BUSINESS PUBLICATIONS. By *Mabel Potter Hanford*. Published by Harper & Bros., New York City. 190 pages. Price, \$2.50.

ALTHOUGH planned primarily as a textbook for publishers and advertisers, this volume will prove a helpful source of factual information for all who are interested in industrial selling and market research. The author, who is said to be the most important purchaser of business paper advertising in America,

has made a keen study of editorial and other qualities that determine the effectiveness with which a publication serves its readership.

### COMBUSTION CHARACTERISTICS

COMBUSTION, FLAMES, AND EXPLOSIONS OF GASES. By *Bernard Lewis and Guenther von Elbe*. Published by the Macmillan Co., New York City. 415 pages. Price, \$5.50.

Reviewed by *Louis C. Roess*

THE LACK of an authoritative coordination and critical appraisal of the scattered literature on combustion, together with the increasing importance of the chain reaction theory in explaining combustion of hydrocarbons, has emphasized the need for a book on this subject. That Lewis and von Elbe are well qualified to fill this need has been shown by their many important contributions to the literature.

The new book is divided into four parts. Part I deals with the chemistry and kinetics of the reactions between fuel gases and oxygen, including the theory of thermal and chain reactions, the oxidation of hydrogen, carbon monoxide, and hydrocarbons, and the theory of spark ignition. Part II deals with flame propagation, including limits of flammability, flame characteristics, the theory of burning velocity, and detonation. Part III treats the state of the burned gas. Part IV reviews the present-day knowledge of flame propagation and knock in internal combustion engines. The book concludes with three useful appendices containing data for thermodynamics calculations, limits of flammability of many fuels, and the flame temperatures of many combustion reactions.

It is regrettable that the authors did not even mention the very plausible explanation of spin in detonation which has been given by Bone, Frazer, and Wheeler. The authors have not made the factors controlling ignition lag in its application to engine knock very clear, and appear to over-emphasize the effect of pressure on the lag in examples where it appears obvious that temperature must be the determining factor.

Such small and debatable faults, however, do not detract from the great value which the book will have for chemists, physicists, and engineers interested in combustion research in general and in internal combustion engines in particular.

### ATOMS AND MOLECULES

THE FINE STRUCTURE OF MATTER. By *C. H. Douglas Clark*. Published by John Wiley & Sons, Inc., New York City. 216 pages. Price, \$4.25.

THIS is Volume II of a treatise on atomic and molecular structure. The set is a comprehensive and fairly critical summary of the recent literature. Volume I dealt with the electronic structure and properties of matter. The present book

is concerned with the determination by means of x-ray measurements of the crystal structure of both inorganic and organic substances. The presentation is non-mathematical and offers a compact assemblage of the available data. It is interesting to note the advances made in the study of the long chain fatty molecules and of complex structures as carbohydrates and the proteins. The subject matter is too specialized to be of general interest. Vol. III, now in process of publication, will be a monograph on spectroscopy.

### UNIT OPERATIONS EQUIPMENT

UNIT OPERATIONS LABORATORY EQUIPMENT. By *O. T. Zimmerman and Irvin Lavine*. Published by the University of North Dakota, Grand Forks, N. D. 110 pages.

NOT ONLY complete working plans and cost data for the construction of ten pieces of essential equipment for a chemical engineering unit operations laboratory are given, but also detailed suggestions for typical student experiments to be performed on the equipment described. A whole section of additional cost data is included which will be helpful in classroom work such as plant design. The manual will fill a need, particularly where funds for purchasing ready-made equipment are limited.

### ORGANIC PRINCIPLES

PRINCIPLES OF ORGANIC CHEMISTRY. By *H. P. Starck*. Published by Chemical Publishing Co. of N. Y., Inc., New York City. 664 pages. Price, \$5.

Reviewed by *R. L. Taylor*

AN ENGLISH TEXT written primarily for premedical, pharmaceutical and general chemistry students, this work stresses the laboratory aspects of organic chemistry with emphasis on properties, reactions and preparation of compounds. About a third of the book is devoted to chemical and physical tests and determination of molecular weights and appears to be very well done.

The descriptions of industrial methods of preparation of important organic compounds, however, aside from being subordinated to laboratory methods, are not up to date with respect to modern practice in America. In the preparation of acetic acid, for example, wood distillation is described as the principal "large-scale" method, while oxidation of acetaldehyde is merely mentioned as used "on the large scale during the World War." The only method given for preparation of acetic anhydride is distillation of sodium acetate and acetyl chloride. No mention is made of the important group of industrial solvents derived from ethylene.

This book is more suitable for the pharmaceutical and biological chemist than for the industrial man.



## SCIENTIFIC CARRYALL

VAN NOSTRAND'S SCIENTIFIC ENCYCLOPEDIA. Published by D. Van Nostrand Co., Inc., New York City. 1234 pages. Price, \$10.

A REMARKABLY complete coverage of the terms of the physical sciences, mathematics, medicine, and the various branches of engineering is accomplished in this single volume. The book is the first of its kind to appear in the technical or even general scientific reference literature.

The usual self-indexing, encyclopedic arrangement is followed, and descrip-

tions and explanations range from a few lines to several pages, depending on the importance of the subject. Prof. Ralph K. Strong of Rose Polytechnic Institute is the contributing editor on chemistry, and Prof. Frederick T. Morse of the University of Virginia handled the items on engineering.

It is not expected that chemical engineers will use this as a dictionary or handbook of their own profession, but in their constant day-to-day contacts with the other sciences they will find it a most valuable reference to have within easy reach.

## GOVERNMENT PUBLICATIONS

*Documents are available at prices indicated from superintendent of Documents, Government Printing Office, Washington, D. C. Send cash or money order; stamps and personal checks not accepted. When no price is indicated pamphlet is free and should be ordered from bureau responsible for its issue.*

**Foreign Commerce Yearbook 1937.** Bureau of Foreign and Domestic Commerce; \$1.00.

**Foreign Commerce and Navigation of the United States. Calendar Year 1936, Volume II.** Bureau of Foreign and Domestic Commerce; \$1.50.

**Specifications, Tolerances, and Regulations for Commercial Weights and Measures and Weighing and Measuring Devices.** Bureau of Standards, Handbook H22; 50 cents.

**Gas Calorimeter Tables.** Bureau of Standards, Circular C417; 10 cents.

**Census Data.** Reports on the production of various commodities in 1937 by Census of Manufactures are now beginning. Preliminary mimeographed reports thus far issued include: rayon and allied products; cigarettes; and numerous non-chemical groups.

**Commodity Specifications.** Index of Federal Specifications, Federal Standard Stock Catalog, Revised to May 1, 1938. Procurement Division, Treasury Department; 15 cents.

**National Munitions Control Board.** Second Annual Report for the year ending November 30, 1937. Available from National Munitions Control Board.

**The Tung Oil Blue Book.** by C. C. Concannon. Production in America and the situation in world markets relative to other drying oils. Bureau of Foreign and Domestic Commerce processed document.

**Selenium as a Potential Industrial Hazard.** by H. C. Dudley. Public Health Service, Reprint No. 1910; 5 cents.

**Harmful Industrial Dusts.** by R. R. Sayers. Public Health Service, Reprint No. 1906; 5 cents.

**Planning the Organization and Conduct of Stream Pollution Surveys.** by J. K. Hoskins. Public Health Service, Reprint No. 1931; 5 cents.

**Nitrogen-Fixing Bacteria and Legumes.** by Lewis T. Leonard. Department of Agriculture, Farmers' Bulletin No. 1784; 5 cents.

**Making Lime on the Farm.** by N. A. Kessler. Department of Agriculture, Farmers' Bulletin No. 1801; 5 cents.

**Changes in Import Duties since the Passage of the Tariff Act of 1930.** Supplement to Third Edition of Printed Pamphlet. June 1938. Tariff Commission unnumbered mimeographed pamphlet.

**World Chemical Developments in 1937.** by C. C. Concannon and A. H. Swift.

Bureau of Foreign and Domestic Commerce, Trade Promotion Series No. 177; 25 cents.

**Rubber Statistics 1900-1937.** by P. W. Barker. Bureau of Foreign and Domestic Commerce, Trade Promotion Series No. 181; 10 cents.

**Copper Mining in North America.** by E. D. Gardner, C. H. Johnson and B. S. Butler. Bureau of Mines, Bulletin No. 405; 40 cents.

**Classification of Cotton.** Department of Agriculture, Miscellaneous Publication No. 310; 10 cents.

**Wheat Smuts and Their Control.** by R. W. Leukel, J. A. Faris, V. F. Tapke, and H. A. Rodenhiser. Department of Agriculture, Farmers Bulletin No. 1711; 5 cents.

**The Toxicity of Haplophyton Cnicoidum A. DC. to Fruitflies.** by C. C. Plummer. Department of Agriculture, Circular 435; 5 cents.

**Soybeans in the United States; Recent Trends and Present Economic Status.** by Ernest W. Grove. Department of Agriculture, Technical Bulletin No. 619; 5 cents.

**Statistics of Building Construction, 1920 to 1937.** Department of Labor, Bureau of Labor Statistics Bulletin No. 650; 15 cents.

**Antitrust Laws with Amendments, 1890-1937.** Compiled by Document Room, House of Representatives; 10 cents.

**Inspection Manual.** Loose-leaf assembly of suggested instructions, forms, and records which operating executives can use for the enforcement of safety and health, hours, minimum wage, child labor, industrial home work, wage payment, and wage collection laws. Department of Labor, Division of Labor Standards Bulletin No. 20; 50 cents.

**Metalliferous Mineral Deposits of the Cascade Range in Oregon.** by Eugene Callaghan and A. F. Buddington. U. S. Geological Survey Bulletin 803; \$1.25.

**Production and Sales of Coal-Tar Dyes by Classes of Application, 1937.** Tariff Commission unnumbered mimeographed pamphlet.

**Willing-To-Certify Sources of Supply of Paints, Pigments, Varnishes and Products Covered by Federal Specifications.** Bureau of Standards, Letter Circular 256a; mimeographed.

**Cooperative Fuel Research Motor-Gasoline Survey, Winter 1937-38.** by E. C. Lane. Bureau of Mines, Report of Investigations 3408; mimeographed.

**Study of a Solvent Analytical Separation of Waxes from Petroleum and Its Lubricating Fractions.** by Joseph W. Horne and W. C. Holliman. Bureau of Mines Technical Paper 583; 10 cents.

**Mineral Statistics for 1937.** Numerous additional pamphlets, preprints of chapters, have been issued by the Bureau of Mines. The bound Minerals Yearbook is expected in August. Pamphlets are 5 cents each.

**Dust Sampling with the Bureau of Mines Midget Impinger, Using a New Hand-Operated Pump.** by J. B. Littlefield and H. H. Schrenk. Bureau of Mines, Report of Investigations 3387; mimeographed.

**Efficiency of Impingers for Collecting Lead Dusts and Fumes.** by J. B. Littlefield, Florence L. Felcht, and H. H. Schrenk. Bureau of Mines, Report of Investigations 3401; mimeographed.

**Extinction of Propylene Flames by Diluting with Nitrogen and Carbon Dioxide and Some Observations on the Explosive Properties of Propylene.** by G. W. Jones and R. E. Kennedy. Bureau of Mines, Report of Investigations 3395; mimeographed.

**Flotation and Agglomerate Concentration of Nonmetallic Minerals.** by Oliver C. Ralston. Bureau of Mines, Report of Investigations 3397; mimeographed.

**Bureau of Mines Apparatus for Determining the Dew Point of Gases under Pressure.** by W. M. Deaton and E. M. Frost, Jr. Bureau of Mines, Report of Investigations 3399; mimeographed.

**Friability of Alabama Coals.** by Ellis S. Hertzog and James R. Cudworth. Bureau of Mines, Report of Investigations 3384; mimeographed.

**Mineral Physics Studies.** including reports on: Physicochemical Nature of Metallic Interfaces; Development and Application of the Coercimeter; Construction and Operation of a Magnetic Balance; Coercive Force of Rods Deformed by Torsion; Sonic Flocculator as a Fume Settler; Theory and Practice; and Effect of Lattice Discontinuities on the Magnetic Properties of Magnetite. Bureau of Mines, Report of Investigations 3400; mimeographed.

**Accident Experience of Louisiana Salt Mines.** by Eric H. Brown. Bureau of Mines, Information Circular 7005; mimeographed.

**List of Permissible Mine Equipment Approved During 1937.** by L. C. Hsley. Bureau of Mines, Information Circular 7007; mimeographed.

**Bureau of Mines Haldane Gas-Analysis Apparatus.** by L. B. Berger and H. H. Schrenk. Bureau of Mines, Information Circular 7017; mimeographed.

**Fuel for Permissible Flame Safety Lamps.** by A. B. Hooker and E. J. Coggeshall. Bureau of Mines, Report of Investigations 3389; mimeographed.

**Statistical Abstract of the United States, 1937.** Bureau of Foreign and Domestic Commerce; \$1.50.

**Effect of City Water and Sewerage Facilities on Industrial Markets.** by O. C. Holleran. Bureau of Foreign and Domestic Commerce, Market Research Series No. 17; 10 cents. Available only from Bureau of Foreign and Domestic Commerce.

**Changes in Import Duties since the Passage of the Tariff Act of 1930.** Supplement to Third Edition of Printed Pamphlet. Tariff Commission unnumbered mimeographed pamphlet.

**International Traffic in Arms, Laws and Regulations Administered by the Secretary of State Governing the International Traffic in Arms, Ammunition, and Implements of War and Other Munitions of War.** Fifth Edition. Department of State; 10 cents.



## Machinery, Materials and Products

### Continuous Centrifugal

IN ADDITION to the line of automatic bulk centrifugals announced at the time of the last Chemical Show, Baker Perkins Co., Saginaw, Mich., now has on the market the Baker Perkins-ter Meer continuous centrifugal which is similar to the continuous machines made under the ter Meer patents that have been in use in Europe for the last three or four years. Suited chiefly for the separation of slurries containing free-draining crystalline or fibrous solids, the new machine is at present processing such materials as ammonium sulphate, salt, sodium chlorate, glaubers salt, cellulose acetate, cotton linters and nitro-cotton. An important advantage claimed for the new design is that the solids deposited on the drum are moved to the discharge in a straight horizontal line without interfacial grinding of crystals or shearing action, while the possibility of damaging impact during charging has likewise been minimized.

The machine is of the type employing a perforated drum or basket, open at one end and closed at the other and rotating on a horizontal shaft. Within the drum at the closed end is an annular pusher for discharging the solids, to which a reciprocating motion is given as later to be described. Mounted on the face of the pusher is an inlet funnel for feeding the slurry, the small end of which projects from the open end of the drum. Drum, pusher and feed funnel all rotate at the same speed, but the pusher and feed funnel, which are carried on a quill shaft journaled within the main shaft, are also reciprocated by oil pressure applied to a piston on the quill shaft, which is within a cylinder formed by an enlargement of the main shaft. Oil under pressure of a pump is admitted to alternate sides of the cylinder, paced by an automatic control which permits immediate adjustment of the number of strokes of the pusher per minute. The rotating assembly is carried on two sets of bearings supported on a heavy cast base which contains the oil reservoir. The drum rotates within a housing which separates the liquid from the discharged solids and may also be used for separating a wash liquid from the filtrate proper.

In operation the slurry is fed continuously into the small end of the feed funnel where it is gradually accelerated until it passes into the rear end of the centrifugal drum where a ring of solids deposits on the drum screen as the liquid is spun off. When the pusher takes a stroke toward the discharge end, the solids just deposited are moved a short distance so that, as the pusher recedes on the reverse stroke, an annular space is left for fresh slurry to flow against the screen from the feed funnel. Thus, as the pusher reciprocates, the cake moves in steps toward the discharge—under a wash spray if desired—while new feed enters the zone of separation in similar steps.

Such machines at present are made in sizes from a 30-in. drum to a 54-in. drum, the former having an approximate capacity of 2 or 3 tons of dry crystals per hour, and the latter, over 15 tons per hour. One of the smaller units, producing 3,000 lb. per hour of a heavy crystalline material, is reported to have required but  $5\frac{1}{2}$  kw.

### Portable Hardness Tester

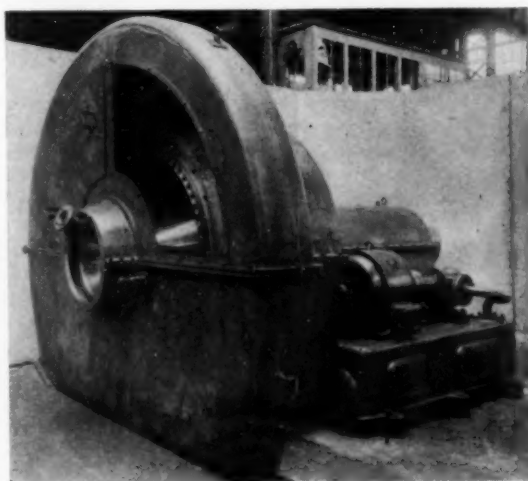
FOR TESTING welds and other metal parts, either in the shop or in the field, Louis C. Eitzen Co., 280 Broadway, New York, N. Y., has introduced a portable Brinell meter, consisting of an instru-

ment within which to nest a standard reference bar, supported in contact with a standard 10 mm. steel Brinell ball. The assembly is placed in position on the surface of the material to be tested, and a plunger within the instrument given a sharp blow with a hammer. The ball produces a simultaneous impression in the bar and in the surface under test and the diameters of the two impressions are then compared by means of a special scale, and the hardness of the test material determined by means of a direct reading table.

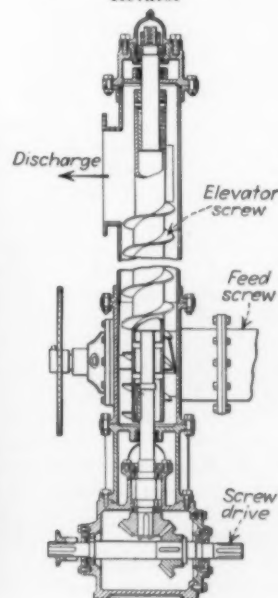
### Vertical Screw Elevator

NEW DESIGN FEATURES, claimed to be directly applicable to vertical conveying, rather than an extrapolation of principles employed in horizontal screw conveying, are found in a new vertical screw elevator developed by Sprout, Waldron & Co., Muncy, Pa. It is claimed that all of the load is lifted and discharges without a part of it surging past the discharge and spiraling downward to make a circulating load. Hence, capacity is said to be larger and power consumption less than in earlier designs of vertical screw eleva-

Baker Perkins-ter Meer continuous centrifugal



Cross-section of vertical screw elevator



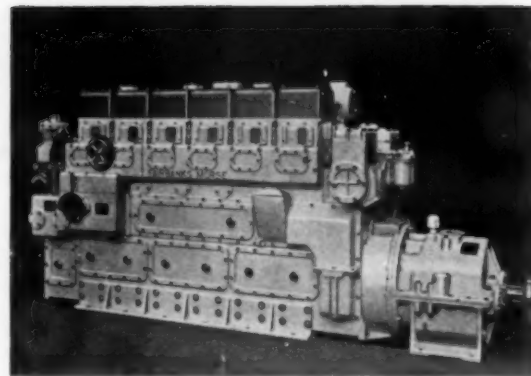
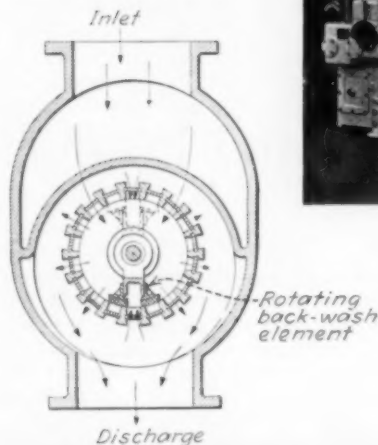
tor, while lifts up to 60 ft. are possible. The elevator is dust-tight and may be jacketed for heating or cooling material in transit. Operating at a speed of 320 r.p.m., the capacity of the screw can be varied from 13 to 712 cu.ft. per hr. by varying the feed rate.

### Self-Cleaning Strainer

AUTOMATIC continuous back-washing for the purpose of cleaning the straining cartridges is the accomplishment of a new self-cleaning strainer, the Type K, recently announced by the Elliott Co., Jeannette, Pa. As appears from the accompanying cross-section, the strainer is divided into a series of straining cartridges supported in pockets in a cylindrical element. A continuously rotating part blanks off each straining cartridge in turn, which is then back-washed by a portion of the strained water. Strainers of this type are made in sizes ranging from 4 to 24 in., for pressures from 25 to 125 lb.

Right—Four-cycle, six-cylinder diesel with reduction gear

Horizontal section of self-cleaning strainer



### Stud Extractor

FOR EASY EXTRACTION of corroded and/or broken pipe and studs, the Reys Tool Co., 220 Delaware Ave., Buffalo, N. Y., has developed a set of extractors which bite at four points at the same time to assure removal. For removing broken pipe, it is only necessary to insert the extractor straight into the pipe and turn with a wrench in the direction opposite to the pipe thread. To remove broken studs and screws, a hole must be drilled in the center of the broken part and the extractor used as indicated above. A set of ten extractors is available for removing pipe ranging in size from  $\frac{1}{8}$  to 2 in. and studs from  $\frac{7}{16}$  to  $3\frac{1}{2}$  in.



Set of stud and pipe extractors

### Convertible Engine

CONVERTIBLE for use either as diesel or as gas engines, the new Model 36-A-8 series has been announced by Fairbanks, Morse & Co., 600 South Michigan Ave., Chicago, Ill. Regularly built in medium speed designs in the 200-300 hp. range, in both six- and eight-cylinder combinations, these machines develop 35 hp. per cylinder at 720 r.p.m. and are available both for stationary and portable service. Enbloc construction is employed, with individual cylinder liners, precision bearings and a suspended crankshaft. The design permits power take-off at either or both ends.

### Pneumatic Micromax Control

EMPLOYING an electrical balance for measurement and a pneumatic balance for control, the new Micromax pneumatic control system recently announced by Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa., is stated to provide a type of regulation in which the action is a direct function of the tem-

perature or other process variable change, as well as a function of the deviation and the rate of deviation. The measuring circuit consists of a Micromax potentiometer of the usual type to the slide wire of which is attached a cam acting through a system of levers to move the stem of a primary pilot valve, causing it to produce a new pressure. For simpler control applications, the pilot valve is sometimes connected directly to the control valve. However, where lags are such as to make this inadvisable, the primary pilot valve is connected to a pneumatic balance which provides automatic reset so as to eliminate drift of the control point. The balance operates a secondary pilot valve which in turn controls the final control valve pressure. If desired, the operator can at any time take over manual control of the process. Both the rate of reset and the throttling range are readily adjustable.

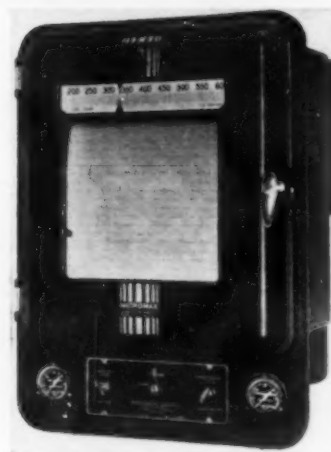
### Equipment Briefs

BLUEPRINT PAPERS of a new type to which the name "Series Sixty" has been given, have recently been announced by Keuffel & Esser Co., Hoboken, N. J. The improved papers are said to produce prints of an unusually deep blue color,

giving a high contrast ratio and making them as legible as original drawings. An advantage claimed for the new papers is an exceptionally wide printing range which makes it possible successfully to print tracings of varying transparency at a single setting of the machine and to produce strong blueprints from any tracing within a broad range of machine speeds.

A COMPLETE LINE of industrial ventilating equipment has been introduced by South Bend Air Products, Inc., 322 East Colfax Ave., South Bend, Ind. Included are two-, four- and six-blade Dynaflo fan units in sizes from 16 to 36 in. in diameter, having air deliveries from 1,240 to 26,000 c.f.m.; also portable fans in sizes from 20 to 36 in. in diameter for use as man coolers, and effective at distances from 50 to 175 ft. Scientifically designed blades and intake rings are said to yield high efficiency. Corrosion-resisting finishes can be supplied if necessary.

DESIGNED primarily for installation as an integral part of processing equipment, a new interval timer powered by a synchronous motor has been introduced by R. W. Cramer & Co., 67 Irving Pl., New York, N. Y. The motor is of the slow speed self-starting type, operating in oil. The switch is a quick-acting type with silver contacts rated at 10 amp. at 120 volts a.c., contacts being normally open,



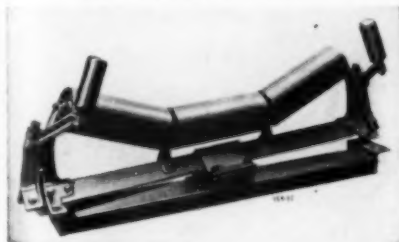
Micromax pneumatic controller

normally closed or of the double-throw type, as desired. Timing scales range from 1 min. with divisions in seconds, up to 8 hours with 15-min. divisions. If desired, a delayed start button and automatic stop are available.

AS A NEW FEATURE in its Fulscope Micromax controllers, the Taylor Instrument Cos., Rochester, N. Y., have introduced a manual bypass as standard equipment, so as to make possible hand control in certain applications for starting the apparatus. Readily accessible knobs are provided for changing from manual to automatic control and for regulating the air supply pressure so that the control valve opening under manual control may be brought to that under automatic control.

INDUSTRIAL ENGINEERS, INC., 819-A East 59th St., Los Angeles, Calif., has recently introduced an improved model of its vapor pressure recorder which furnishes continuous records of the temperature at which the vapor pressure of the sample is measured, and of the vapor pressure of the sample. The instrument makes use of a thermostatically controlled oil bath containing an agitator through which the continuous sample is passed before entering a submerged cup in which the temperature and vapor pressure are measured. A sample of any size between 3 and 10 g.p.h. gives satisfactory results. The sample flows through the machine under its own pressure at a controlled rate of flow. Having been raised to the oil bath temperature, it is jetted into the evaporator cup where the

Self-aligning belt idler



Respirator for lead and Type A dusts



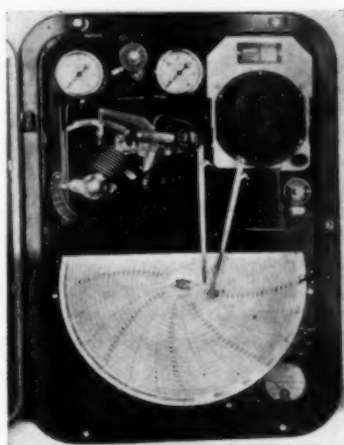
vapors already present are mixed with the incoming liquid and vapor, thus establishing equilibrium at the test temperature.

TO ELIMINATE galling of threads due to atmospheric corrosion, the Henry Vogt Machine Co., Louisville, Ky., is now supplying drop forged steel valves with Parkerized valve bonnets, bonnet nuts, packing glands and packing nuts. Another feature is an identification disk held in place by the hand-wheel nut on which is recorded the valve size, catalog number, working pressure, temperature and trim style.

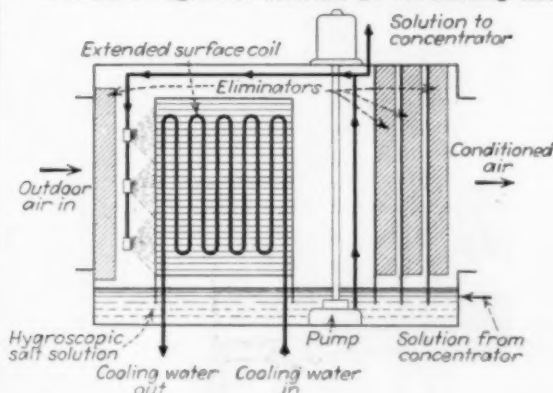
### Large-Area Respirator

FOR PROTECTION against Type A and lead dusts, including such materials as quartz, cement, asbestos, charcoal, storage battery ingredients, ceramic ingredients and lead salts, the Chicago Eye Shield Co., 2300 Warren Blvd., Chicago, Ill., has developed a new style respirator having an effective breathing area of more than 45 sq.in. Anatomically shaped face cushions, a non-collapsible exhale valve, light weight and no obstruction to talking and vision, are important features claimed for the new Style 92 mask. It has been approved by the U. S. Bureau of Mines for the types of hazards mentioned above.

Pneumatic reset potentiometer



Schematic diagram of Calorider air conditioning unit



### Conveyor Idlers

TWO NEW DESIGNS of anti-friction idlers for conveyor belts have recently been put on the market by the Jeffrey Mfg. Co., Columbus, Ohio. One is an inexpensive ball-bearing idler for moderate loads, which is of the conventional three-pulley, 20-deg. troughing type, made in widths from 14 to 36 in. The other is a self-aligning idler for automatically training conveyor belts without damage to the belt, consisting of a standard anti-friction idler pivotally mounted on a supporting cross member, with guide rolls at each end. These guide rolls, as shown in the accompanying view, may be pivoted through 180 deg. for training the belt when traveling in the opposite direction.

### Reset Controller

THE BRISTOL CO., Waterbury, Conn., has recently announced two new instruments of the reset type, provided with adjustments whereby the throttling range and rate of reset can be suited as desired to meet conditions in the field. One of these instruments is an air-operated Free-Vane controller for the regulation of such variables as temperature, pressure, vacuum, flow and liquid level. In this controller any load change accompanied by a movement of the pen away from the control point produces a change in the controlled air pressure sufficient to bring the variable back to the control point. The reset operating mechanism brings about this change automatically at a rate corresponding to that required by the process under control.

This principle has also been applied to the company's Pyromaster potentiometer temperature measuring system, which is now being combined with the reset Free-Vane air-operated control mechanism for certain applications. Suitable for temperatures to 3,000 deg. F., the new combination instrument may employ either a thermocouple or a resistance thermometer as the sensitive element. In this device the measuring system is electrical, while the control system is pneumatic. Its features of adjustability are the same as those employed in the controller described above.

### Chemical Dehumidifier

AFTER SEVERAL YEARS' experience with chemical dehumidification, the Research Corp., 405 Lexington Ave., New York, N. Y., has announced the Calorider system of dehumidification and air conditioning. Humidity control is accomplished by the use of a hygroscopic salt solution which is sprayed on to an extended-surface cooling coil over which the air passes. During removal of the moisture by the solution, the heat of condensation is thus simultaneously taken up by cooling water circulating through the coil. In order to hold the salt solution at the proper concentration



for the desired equilibrium humidity conditions, a concentrator is provided in which approximately one-fifth of the circulating solution from the dehumidifier is sprayed downward over a heating coil, counter to a flow of air drawn upward through the concentrator and exhausted to the atmosphere.

Cooling water may be either well water, city water or recirculated water passed through an evaporative cooler, depending on circumstances. It is stated that city water can generally be used for smaller jobs. Among the advantages claimed for the system is the fact that in industrial applications, independent control of temperature and humidity can be obtained at low cost, because low-pressure or waste steam can be used for the brine concentration. It is pointed out that the load on the system varies directly with the variation of outside air conditions from those desired. With the all-year controls provided, the equipment is adapted for automatic reversal from cooling and dehumidifying, to heating and dehumidifying, as conditions may require.

### Generator Set

AUTOMATIC voltage control is provided in a new voltage generator set for the anodic treatment of aluminum, recently developed by the Hanson-Van Winkle-Munning Co., Matawan, N. J. The new set is larger than that ordinarily used in the past and is equipped with automatic control devices designed to vary the generator voltage through a predetermined cycle of values as required for the specified treatment of a batch of aluminum parts. The normal rating is 1,500 amp. at 50 volts.

For normal application, parts to be anodized are cleaned and hung in the bath and the operator presses a button to set the automatic control in operation. Automatically, the voltage is raised as desired for a definite period of time after which it is held constant as long as necessary until treatment is completed, when the device automatically shuts off and signals the operator.

### Knife Cutter

FOR HEAVY-DUTY cutting, granulating and shredding of many kinds of plastic, tough and fibrous materials such as rubber tires, leather scraps, plastic compounds, bark, pulp, etc., the Robinson Mfg. Co., Muncy, Pa., is offering a new heavy-duty knife cutter. As shown in the accompanying cross-section, this machine features a removable cover plate placed in front of each stationary knife to permit inspection and ready adjustment of the clearance between stationary and rotating knives. The knives are extra heavy and the cutting edges faced with inserts of high carbon steel. A semi-circular screen holds material within the cutting chamber until it is fine enough

to pass through. Heavy duty self-aligning bearings are supported in bearing housings cast integral with the ends of the machine. The balance wheel through which the belt drive is obtained is provided with shear pins to protect the machine against damage from metallic substances which accidentally enter the cutting chamber.

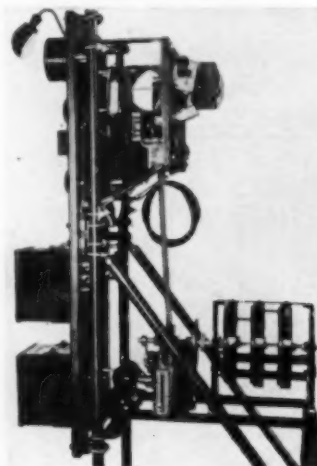
### Ribbon Heat Exchanger

CONDENSER SERVICE & ENGINEERING Co., 310 Twelfth St., Hoboken, N. J., has announced a new ribbon counterflow heat exchanger and cooler which employs narrow, flat passageways for both fluids. There are no gasketed joints to permit leakage and all heat transfer surfaces are readily accessible for cleaning. Passageways have been designed to reduce turbulence and friction losses and are thin to secure intimate contact. In liquid-to-liquid performance tests with clean surfaces, heat transfer rates of over 500 B.t.u. per hour, sq.ft. and deg. F. are said to have been obtained.

### Indicating Controller

CLOSELY FOLLOWING the development of its wide-range non-indicating controller, the American Schaeffer & Budenberg Division of Manning, Maxwell & Moore, Inc., Bridgeport, Conn., has announced the American wide-range indicating controller. This combines the earlier non-indicating instrument with a standard dial thermometer, the two units being mounted on an aluminum panel drilled and ready for mounting. The sensitive element is a vapor pressure thermometer with a single bulb operating both the controller and the dial thermometer in parallel. An exterior control key is provided for setting the control point. Two gages show the supply air pressure and the pressure on the controlled diaphragm valve. Various control ranges in the range from -30 to 500 deg. F. are available.

Side view of control panel for anodic treatment

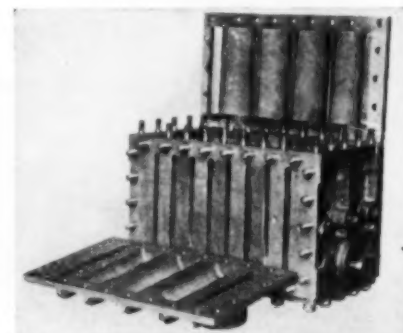


### Weld Preheating System

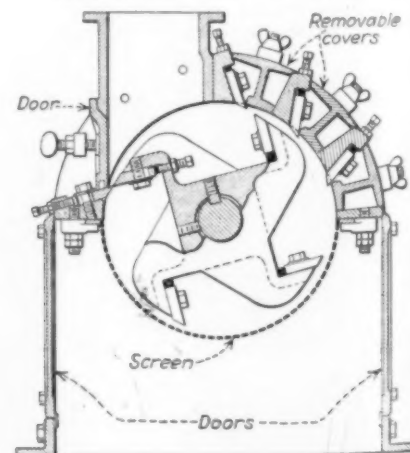
RIGHTS have been secured by the Electric Arc Cutting & Welding Co., Newark, N. J., to promote the use of a new electric preheating and normalizing process for use in the electric welding of alloy pressure piping. This method employs specially arranged coils of wire on either side of the weld through which a 60-cycle current is fed at predetermined amperage, according to the size of the pipe. Heating is accomplished by hysteresis and eddy current losses in the pipe and is employed in preheating the pipe to the desired temperature before welding, holding whatever temperature may be desired during welding and during periods of interruption, and finally raising the temperature and holding it at the desired normalizing temperature after welding has been completed.

It is claimed that this is not a stress relief method, in that stresses are never permitted to develop either in the weld or in the parent metal. Thus it is claimed to be possible to obtain the best possible physical properties in the weld. The system permits accurate temperature control at all times by using a recording pyrometer and a switching arrangement for holding the temperature at any desired level. Welds produced by the new method are said to be equal to, if not better than, those produced by any other method.

Ribbon heat exchanger with covers removed



Cross-section of new knife cutter



## MANUFACTURERS' LATEST PUBLICATIONS

**Alloys.** Climax Molybdenum Co., 500 Fifth Ave., New York City—Looseleaf handbook of 13 sections dealing with molybdenum in steel, covering a variety of steel alloys containing molybdenum for many types of service, including resistance to temperature and corrosion.

**Alloys.** Revere Copper & Brass, Inc., 230 Park Ave., New York City—4-page reprint of an article summarizing important properties and typical industrial application of 30 representative coppers and copper-base alloys, with 4-page chart on physical properties and uses.

**Cements.** Haveg Corp., Newark, Del.—Bulletin N-1—2-page leaflet describing this company's cold-setting, acid-resisting cement, with information on properties, uses and chemical resistance.

**Chemicals.** Carbide & Carbon Chemicals Corp., 30 East 42d St., New York City—80-page Ninth Edition of "Synthetic Organic Chemicals," with data on properties and uses of the 105 industrial organic chemicals made by this company. Includes new data and covers properties of 29 new chemicals commercially available since the last issue of this catalog.

**Chemicals.** The Neville Co., Neville Island, Pittsburgh, Pa.—8-page booklet on this company's plasticizing oils, covering specifications, properties and uses of four types.

**Chemical Stoneware.** General Ceramics Co., 30 Rockefeller Plaza, New York City—100-page looseleaf general catalog covering this company's complete line of chemical stoneware for process industries with complete dimensions and other information on pipe and fittings, tanks and jars, pumps, towers, filters, condensers and other equipment.

**Coatings.** Amercoat Sales Agency, 5905 Pacific Blvd., Huntington Park, Calif.—16 pages on Amercoat coatings for the protection of concrete, metal and wood surfaces.

**Construction.** The Master Builders Co., 7016 Euclid Ave., Cleveland, Ohio—20-page book describing the application of this company's product, Pozzolith, a dry type water-reducing plasticizer for concrete which is said markedly to reduce water requirements in mixing, at the same time increasing the strength of the finished concrete.

**Disintegration.** Allis-Chalmers Mfg. Co., Milwaukee, Wis.—Bulletin 1467-A—16 pages covering design and applications of this company's swing-hammer pulverizers for coal, limestone and other non-abrasive materials, with size and capacity tables.

**Disintegration.** Raymond Pulverizer Division, Combustion Engineering Co., 1316 North Branch St., Chicago, Ill.—Bulletin 28—4 pages describing a new direct-motor-connected laboratory swing-hammer pulverizer, equipped with screens and a screw feeder.

**Dust Collection.** Buell Engineering Co., 70 Pine St., New York City—8-page booklet describing the Buell dust collector (Van Tongeren system) with information on applications, performance and the company's testing facilities.

**Dust Collection.** W. W. Sly Mfg. Co., 4700 Train Ave., Cleveland, Ohio—Bulletins 90 and 91—Respectively, 24 pages describing this company's cloth-type dust filters in detail; and 4 pages describing the "Centri-Merge" wet dust collector manufactured under the Schmiege patents.

**Electrical Equipment.** General Electric Co., Schenectady, N. Y.—Bulletin GEA-2963—4 pages describing the Type TSA-14 short-cycle automatic repeating timer for process control.

**Electrical Equipment.** Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.—Descriptive Data 33-675—12 pages on this company's Type U De-Ion air circuit breakers for indoor industrial service.

**Equipment.** First Machinery Corp., 419 Lafayette St., New York City—General Catalog 39—20-page catalog briefly describing a wide range of rebuilt process equipment; also new machinery manufactured and handled by this company.

**Equipment.** Heil & Co., 3088 West 106th St., Cleveland, Ohio—Publications as follows: Data Sheet 652 describes a thermoplastic tank lining material, Plast-O-Line, for acid resistance; Bulletin 48 describes acidproof brick linings; Bulletin 50 illustrates a variety of lined tanks, heating devices and other fabricated equipment.

**Equipment.** Yarnall - Waring Co., Chestnut Hill, Philadelphia, Pa.—Bulletin G-1304—12 pages briefly describing this company's steam plant equipment including seatless and swing-gate valves, tandem blow-off valves, water columns, expansion joints, spray nozzles and steam traps.

**Fans.** The Green Fuel Economizer Co., Beacon, N. Y.—Bulletin 166—36 pages on this company's mechanical draft fan with information on characteristics of various types of blade construction, and on volume control methods.

**Fans.** Kirk & Blum Mfg. Co., Cincinnati, Ohio—Bulletin V—32 pages describing the application of this company's fan systems in a variety of industries, for materials handling, drying, ventilating and air conditioning.

**Fans.** National Association of Fan Manufacturers, 5-208 General Motors Bldg., Detroit, Mich.—Form X-12, Second Edition—12 pages on standard methods adopted for centrifugal fans and blowers, with designations for drive arrangements and direction of rotation and discharge; also comparison chart of fans made by manufacturers belonging to the association.

**Finishes.** The Truscon Laboratories, Detroit, Mich.—4-page leaflet describing this company's new "Flor-Dye" system for coloring and preserving cement floors for industrial and other uses.

**Furnaces.** Bigelow-Liptak Corp., Detroit, Mich.—20-page book describing this company's unit-suspended walls for furnaces, covering construction details, advantages, and savings in maintenance, conduction and air-infiltration.

**Grinding.** Patterson Foundry & Machine Co., East Liverpool, Ohio—4-page leaflet describing results obtained in the grinding of paints, lacquers, enamels, inks, and other similar materials in this company's chrome-manganese mills.

**Heat Exchangers.** American Heat Reclaiming Co., 1270 Sixth Ave., New York City—20-page book describing this company's spiral heat exchanger with information on construction of various types and applications. Also booklet listing numerous installations throughout the world.

**Instruments.** Bailey Meter Co., 1050 Ivanhoe Road, Cleveland, Ohio—Bulletin 102-B—32 pages on this company's air-operated combustion control equipment with detailed information on principles and applications.

**Instruments.** The Bristol Co., Waterbury, Conn.—Bulletin 510—Describes a modern installation of this company's machine-operation recorders for determining idle time, quantity and rate of production, etc.

**Jet Coolers.** Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.—Leaflet F. 8445—6 pages describing construction and operating characteristics of this company's steam jet vacuum coolers for process cooling and air conditioning.

**Materials Handling.** Chain Belt Co., Milwaukee, Wis.—Bulletin 323—32 pages on materials handling equipment for logs and lumber, with particular reference to pulp mills and saw mills.

**Materials Handling.** The Fairbanks Co., 393 Lafayette St., New York City—Catalog 53—22 pages on casters made by this company for many types of materials handling equipment; also covers truck wheels.

**Materials Handling.** Gifford - Wood Co., Hudson, N. Y.—Bulletin 138—16-page booklet describing this company's materials handling equipment and service in designing, installing and periodically checking up on equipment.

**Piping.** Grinnell Co., 260 West Exchange St., Providence, R. I.—4-page leaflet illustrating and giving figure numbers of all types of adjustable pipe hangers and supports made by this company.

**Power Transmission.** Hydraulic Coupling Division, American Blower Corp., 50 West 40th St., New York City—Form 3219—8 pages on this company's traction type hydraulic coupling for the starting of heavy loads and the shockless transmission of power from driving to driven equipment.

**Pumps.** Allis-Chalmers Mfg. Co., Milwaukee, Wis.—Bulletin 1653—32 pages on this company's close-coupled centrifugal pumps in capacities to 1,600 g.p.m. and for heads to 300 ft. Gives dimension and capacity data.

**Safety.** Mine Safety Appliances Co., Braddock, Thomas & Meade Sts., Pittsburgh, Pa.—Bulletin BM2—4 pages describing this company's recently announced lightweight one-hour oxygen breathing apparatus for use in unbreathable atmospheres; also bulletin describing this company's bulletin boards for the display of safety and general bulletins.

**Separators.** Stearns Magnetic Mfg. Co., Milwaukee, Wis.—8-page folder describing this company's spout type magnetic separators in several designs; also magnetic pulley separator units.

**Speed Control.** Reeves Pulley Co., Columbus, Ind.—Catalog G-384—124-page catalog covering this company's complete line of variable speed control equipment, including its three types of transmission in their various forms, with information on various accessory equipment for controlling and adapting to specific applications. Includes application information and extensive dimension and rating tables.

**Turbines.** Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.—Booklet B-2084-A—10 pages describing applications, advantages and construction of this company's Type C steam turbines for mechanical drive in sizes from 5 to 500 hp.

**Valves.** Crane Co., 836 South Michigan Ave., Chicago, Ill.—Circular 307—48-page price list covering all valves listed in the Crane No. 52 catalog and subsequent leaflets.

**Welding.** Aluminum Co. of America, Pittsburgh, Pa.—48-page revised edition of this company's booklet on "Welding Aluminum," giving up-to-date information on fusion, arc and resistance welding of aluminum, aluminum alloys and castings.

**Welding.** Metal & Thermit Corp., 120 Broadway, New York City—34-page book describing Thermit welding and its applications in industry and elsewhere; also 31-page booklet covering Murex arc welding electrodes.



# Chemical Engineering NEWS

## Japanese Chemical Plants Lack Raw Materials

### Special Correspondence

Effects of the drastic rationing of imported raw materials are being felt by the chemical concerns in Japan, some of which have already been forced to suspend production, while others are expected to follow suit.

Imports of rock phosphates have been substantially restricted because of lack of exchange funds. This has induced the Nissan Chemical Industrial Co. to suspend manufacture of superphosphate fertilizers. Other companies have made a considerable reduction in superphosphate production. The same situation has developed in the calcium cyanamide industry, where drastic production curtailment is prevailing.

The pinch is felt more or less by all chemical firms, depending on their usefulness in the military production scheme. Manufacturers of typical peacetime products are most severely hit as supply of raw materials to them has been virtually suspended. This applies to manufacturers of rubber articles other than aircraft and automobile tires, tanning firms and many other branches of the chemical industry. Even where domestic raw materials are available, the firms are compelled to curtail operations because of lack of fuel and electric power, the available supply of which has been diverted to the munitions industries.

Another serious factor is that chemical plant equipment can neither be imported nor manufactured in Japan. Local makers of chemical plant have suspended operation altogether because of lack of steel, nickel, copper and other metals. Most of them have gone in for machine-tool and munitions manufacture to avoid shutdowns.

The export recession that has been noted in almost all major Japanese export items since the outbreak of the Sino-Japanese hostilities has also affected dyestuff shipments to a considerable degree. The adverse development of the trade is mainly due to the dislocation of the China market, which is normally a leading destination for Japanese dyestuffs, and also to restrictive measures enforced in various other markets. Finally it may be taken that Japanese producers have diverted a large part of their capaci-

ties to the production of explosives and other war chemicals. All these factors have combined to reduce exports for the first five months of the current year to less than one-half of the shipments recorded during the corresponding period last year.

## Fall Meeting for T.A.P.P.I. At Green Bay

The General Committee of the Technical Association of the Pulp & Paper Industry, of which A. B. Hansen, vice-president and general manager of the Northern Paper Mills, is general chairman has completed the program for the fall convention of the Association which will be held at Green Bay, Wisc., Sept. 8-10. The Northland Hotel has been selected as headquarters and a general session will open the proceedings on the morning of Sept. 8.

In the afternoon the Forest Products Laboratory technical program will be presented with the following papers scheduled: "Effect of Growth Variables in the Pulping of Western Hemlock by the Sulphite Process" by G. H. Chidester and J. N. McGovern; "The Effect of Modified Soda Base Sulphite Liquors in Pulping" by G. H. Chidester; "Chemistry of the Alkaline Pulping Processes V. Effect of Chemical Ratio and Initial Concentration on the Rate of Delignification and Hydrolysis" by S. L. Schwartz and M. W. Bray; "The Crystalline Arrangement of Holocellulose" by G. H. Ritter and R. L. Mitchell; "Chemical Composition of Holocellulose" by G. H. Ritter and Wm. Van Beckum; and "Lignin Investigations" by E. E. Harris.

A harvest festival costume and ball and dinner with floor show will be held in the evening at Riverside.

On Friday morning, Sept. 9, the Institute of Paper Chemistry technical program will be presented with the following papers listed: "Sulphite Pulping of Douglas Fir" by E. B. Brookbank, Jr.; "An Investigation of the Flocculation of Papermaking Fibers" by J. C. Woolwage; "A Fundamental Study of the Removal of the Constituents of Wood in the Alkaline Cooking Process" by F. E. Brauns and W. S. Grimes; "The Influence of Humidity on Changes in Diameter and Length of Sulphite Fibers" by J. P. Widener; and "An Investigation

of the Optical Scattering and Absorption Coefficients of Dyed Hand Sheets and the Application of the I. C. I. System of Color Specification to These Hand Sheets" by W. J. Foote.

After luncheon, golf and skeet tournaments together with plant visits are planned and in the evening the formal banquet and dance will take place at Riverside.

A general session will open the meeting on Saturday morning Sept. 10, followed by golf and dinner at Maxwellton Braes.

## Chemists Designated To Examine Denaturants

The Treasury Department has issued a list of chemists designated to examine samples of denaturants submitted to them by duly qualified denaturing plants. The list comprises: Prof. Ralph F. Nielson, Atchison, Kans.; John M. Sanford, Terre Haute, Smith, Emery & Co., San Francisco; Paul S. Nice, Denver; Harold E. Tiffany, Wilmington; N. B. Bairos, Honolulu; H. M. Deavitt, Chicago; E. F. Cowperthwaite, Peoria; William E. Janes, Louisville; W. L. Howell, New Orleans; Penniman & Browne, Baltimore; Arthur D. Little, Inc., Cambridge; Charles V. Netz, Minneapolis; Hochstadter Laboratories, New York; Dr. Sigmund Waldbott, Cincinnati; F. C. Broeman & Co., Cincinnati; Samuel P. Sadler & Sons, Inc., Philadelphia; J. R. McTaggart, Pittsburgh; R. del Valle Sarraga, San Juan, Puerto Rico; I. F. Laucks, Seattle; Commercial Testing & Engineering Co., Charleston, W. Va.; and J. F. Steph; Milwaukee.

## Vinyl Acetate Plant Opens At Indian Orchard

The new vinyl acetate resin plant of Shawinigan Resins Corp. at Indian Orchard, Mass., has been completed and is now in production. It is jointly owned by Monsanto Chemical and Shawinigan Chemicals, Ltd., Montreal.

Vinyl acetate sheets for use by glass and motor car manufacturers in a new type of safety glass for automobiles, railroad cars and other vehicles will be the principal product of the plant.

While the glass industry will be the chief user of the new product, many other uses are in the process of development in Monsanto research laboratories in Indian Orchard and Dayton, Ohio, and at the research laboratories of Shawinigan Chemicals at Shawinigan Falls, Quebec.

Production capacity of the plant has been established in anticipation of such developments and also in anticipation of general use of the new type glass throughout the automotive, rail equipment and aircraft industries here and abroad.



## Calcium Chloride Makers Accused of Price Fixing

Four manufacturers alleged to control substantially the entire output of calcium chloride in the United States, and their trade association, are charged in a complaint issued by the Federal Trade Commission with engaging in a conspiracy to fix prices and with using other unlawful methods to restrain and eliminate competition in the sale of their product.

The respondent companies are Columbia Alkali Corp., Barberton, Ohio, Dow Chemical Co., Midland, Mich., Michigan Alkali Co., Wyandotte, Mich., Solvay Process Co., Syracuse, N. Y., and its wholly owned subsidiary, Solvay Sales Corp. Calcium Chloride Association, 4145 Peneboscot Building, Detroit, is the trade association named in the complaint.

Acting directly and through their trade association, the respondent companies, the complaint alleges, in order to better effectuate their agreement to fix and maintain uniform prices, have (1) maintained a uniform zoning system for the United States; (2) suggested retail prices to their individual dealers or distributors; (3) exchanged information with reference to the prices each charges for calcium chloride and concerning their yearly distributions of the product; (4) changed simultaneously, in the same amounts, their sales prices, and (5) offered identical bids for carload and less than carload lots of their product to prospective purchasers. It is further alleged that since 1937 the respondents have, by agreement, eliminated cash discounts for prompt payment by purchasers of calcium chloride.

Operating expenses of the respondent Calcium Chloride Association, the complaint charges, are prorated among the member companies according to the estimated yearly income of each, Dow Chemical Co. and Solvay Sales Corp. each paying 32½ per cent and Columbia Alkali Corp. and Michigan Alkali Co. 17½ per cent each. In addition, Solvay Sales Corp., Columbia Alkali Corp. and Michigan Alkali Co. allegedly pay into a patent fund of the respondent trade association \$12,500 annually in exchange for the right to use a patented process of manufacturing calcium chloride owned by the Dow Chemical Co.

## Few Industrial Loans to Chemical Companies

Industrial loans made by the Reconstruction Finance Corporation during June, as shown by a report submitted to Congress August 4, totalled \$17,656,760.21. This shows a marked increase over May, when such loans totalled \$13,091,802.49. In addition, the RFC joined the banks in loaning \$1,150,610 to

67 different industrial borrowers. This was an increase of nearly \$400,000 over participations purchased in May.

Loans to chemical industries were few. A loan of \$8,000 was authorized for the Growers Fertilizer Co., of Fort Pierce, Fla.; a loan of \$10,000 for the Ceramic Felspar Co., of Trenton; a loan of \$9,000 for the Eugene Chemical Works at Eugene, Ore., and a loan of \$2,250 for the Standard Chemical Engineering Co. of Seattle. The RFC agreed to join with the First National Bank of Somerset in a loan of \$5,000 for the Somerset County Fertilizer Works, Inc., Somerset, Pa.

## Vitamin E Synthesized By Dr. Lee I. Smith

Vitamin E, the anti-sterility vitamin, has been synthesized by Dr. Lee I. Smith, head of the division of organic chemistry of the University of Minnesota. Dr. Smith, who has been for many years specializing in pure synthetic research, discovered that a number of the compounds which he had been working on were closely related to the products of decomposition of Vitamin E. He, therefore, modified his work a few months ago with a view to attempting synthesis of this compound which he has discovered to be alpha tocopherol. This new discovery forms a basis of a number of patent applications which have been assigned to the University for development. It appears that commercial synthesis should be neither difficult nor expensive. There is some question, however, whether a single compound is required. Dr. Smith postulates that a whole family of compounds closely related chemically are probably needed to cover the whole field of anti-sterility vitamins for various forms of animal life.

## Dr. Kunsman Will Attend Fertilizer Congress

Dr. C. H. Kunsman, Chief of the Fertilizer Research Division of the Bureau of Chemistry and Soils of the Department of Agriculture, sailed August 5 for Europe to attend the first International Fertilizer Congress to be held in Rome, October 3 to 6. He is the only American on the program. His paper is entitled "Fertilization With Compound Fertilizers." Before sailing Dr. Kunsman explained that the three day session will be devoted principally to phases of the raw material situation; to problems connected with the application of fertilizers; to educational work in the fertilizer field and to certain of the economic aspects surrounding the industry. In the course of his paper Dr. Kunsman will summarize the returns obtained from a questionnaire on mixed fertilizers which was sent to chemists in the principal countries of the world.

## Du Pont Develops Synthetic Bristling Filament

"Exton", a new bristling filament for use in toilet brushes, has just been announced by the plastics department of E. I. du Pont de Nemours & Co. as the result of several years of research and experimentation. The present production is limited and the entire output is being used in du Pont's own tooth brush manufacture.

The new bristling filament is ultimately expected to replace the natural hog bristle which has heretofore been used in the best grades of toilet brushes. Made in the form of a plastic batch, it is extruded through holes of the required size and can be made into strands of virtually any desired length. It is not softened by water or saliva. Its stiffness can be controlled accurately in the making through a variation of the diameter of the hole.

## First Contract for Sale Of Bonneville Power

The Federal Power Commission has approved a temporary and experimental rate schedule incorporated in a contract dated July 26, executed between J. D. Ross, Administrator of the Bonneville Project, and the Northwestern Electric Co. covering the sale and disposition of power from the Bonneville Project for a period not to extend beyond October 31, 1938. This is the first contract covering the sale of Bonneville power submitted to the Commission.

The rate for prime power is to be based upon Wholesale Rate Schedule C-1 (Transmission System Prime Power), the rate for which is \$17.50 per kilowatt year, and the rate for secondary power is to be based upon Wholesale Rate Schedule D-1 (Transmission System Secondary Power) the rate for which is \$11.50 per kilowatt year.

## Herrick Will Supervise Regional Laboratories

H. T. Herrick has been named assistant chief of the Bureau of Chemistry and Soils with the responsibility for planning and direction of the chemical and chemical-engineering work which will be carried out in the four regional laboratories to be established by the Department of Agriculture. Mr. Herrick heads the committee of the Department which is surveying the present research of the country which deals with industrial use of agricultural materials. The results of this survey will determine in large measure the plans for initial investigations for the four new \$1,000,000 per year laboratories.

**M**ONOPOLY investigations by the committee of Congress and Department representatives will begin hearings late in September or early in October in an effort to provide justification for a new anti-monopoly law which will become an Administration measure at the beginning of the next Congress. Two fundamental technical questions of great importance to process industry are being studied—patents and tariffs. There is considerable likelihood that both of these subjects will form important parts of new restrictive legislation next year.

The reform element in the Administration is thoroughly convinced that patents are very often used as a basis for monopolies. They propose to eliminate this opportunity. Apparently the major argument in support of their theory is the large number of patents owned by big firms but not used by them in manufacture. It is claimed that these patents are being "suppressed," with detriment to the public. It still appears, therefore, that the most likely form of this new legislation will be a law to provide for compulsory licensing by a patent owner of any patents which he does not actively work. There is some chance also that the life of patents for exclusive protection of inventors and owners will be shortened.

#### Tariff Changes

Very little attention has been given to the fact that some of these same New Deal leaders believe that tariffs are often used for the establishment of monopolies in much the same way that patents are used. There is considerable likelihood that the anti-monopoly investigators will formulate some recommendations regarding the curtailment of duties on goods made by a single manufacturer, or a very limited number of firms. It is not quite clear how this policy can be developed without opening up the whole question of a general tariff revision. But some effort in this direction is probable. Success does not seem very likely, but the effort cannot safely be ignored.

Other tariff reductions which are being considered in connection with trade agreement negotiations interest the chemical industry slightly. The list of commodities being considered in negotiations with Venezuela includes certain agricultural materials used as a source of natural medicinals, flavors (vanilla), dyes, and other products. Also significant are possible cuts on both caustic calcined magnesite and dead-burned magnesite. No one will say when (or whether) the revised Canadian agreement or the most important agreement with the United Kingdom can be expected.

Without waiting for committee recommendations, the Department of Justice is aggressively prosecuting a number of

## NEWS FROM WASHINGTON



Washington News Bureau  
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Paul Wooton, Chief

anti-trust cases, notably petroleum and motion picture groups. No one knows where the lightning may strike next, possibly in process industry such as rubber, cement, or electrometallurgy.

#### Fumigation Rules

Proceeding further in its Japanese beetle quarantine the Department of Agriculture has issued instruction to govern the fumigation of refrigerator cars containing onions. These regulations though applicable in detail only for this single vegetable represent typical requirement of the Department to protect against the transfer of beetles out of quarantine areas by agricultural materials. Prescribed treatment method is as follows:

"Fumigation of onions in dry refrigerator cars with methyl bromide at a dosage of 2 pounds per 1,000 cubic feet of space, including the space occupied by the onions and bunkers of the cars, for a period of 2 hours, during which time the car shall remain tightly closed with the plugs in place in the ventilator hatches. The temperature within the car when fumigated shall be not less than 70° F. Provision shall be made for circulating the mixture of air and fumigant in the car for as long a time as is deemed necessary by the inspector. At the end of the fumigation period the hatches shall be opened, the plugs removed, screens placed in the hatch openings, and the car shipped under standard ventilation."

#### "New Drug" Defined

Under the federal Food, Drug, and Cosmetic Act of 1938 the federal Government restricts the use of new drugs potentially dangerous. Under this law the Food and Drug Administration has formulated a set of regulations which indicate the very sweeping character of the contemplated regulation. Chemical manu-

facturers may find under certain circumstances that their commodities are subject to regulation because of the following broad definition which is formulated under Section 201 (p) of the law.

"A drug may be a new drug by reason of—"(1) the newness for drug use of any substance which composes the drug, in whole or in part, whether it be an active substance or a menstruum, excipient, carrier, coating, or other component; "(2) the newness for drug use of a combination of two or more substances, none of which is a new drug; "(3) the newness for drug use of the proportions of the substances in a combination even though the substances in certain other proportions do not constitute a new drug; or "(4) the newness of the dosage, or methods or duration of administration or application, or other conditions of use of the drug prescribed, recommended or suggested in the labeling thereof, even though the drug is not a new drug when used in certain different dosage, or in different methods or duration of administration or application, or in conditions that are otherwise different."

#### Valley Inquiry

Washington continues to believe that the T.V.A. inquiry is not going to reveal dishonesty or malfeasance in office in the ordinary sense of these words. But it has clearly revealed a bitter conflict of personalities among the three directors which accounts for much of the confusion which has always prevailed in the administrative actions and the public utterances from the Authority.

Large significance was attached during late July hearings to the purchase by T.V.A. of phosphate lands bought from International Agricultural Corporation at a price that gave that firm a profit of about \$500,000. It appears, however, that these purchases are being explained by the executives of the Authority to the satisfaction of the investigating committee. It is evident that a thorough inquiry was made before the purchase was agreed on and the committee seems convinced that a business-like proceeding required such purchase in order to get the requisite phosphate rock supply for the fertilizer plants at a minimum unit cost per ton of acceptable rock.

There is no present evidence that power contracts with large industrial firms in the chemical industry will be disturbed or that the present power rates are likely to be very much modified by these proceedings. Furthermore, reputation smearing is being kept at a minimum by the committee through its rather matter-of-fact handling of controversial cases. It seems likely that the reputation of those involved will suffer more because of their faulty administrative ability than from any other single cause, or perhaps from all other causes put together.



## BRITISH PETROLEUM TECHNOLOGISTS CONFER ON OIL SHALES AND CANNEL COAL

From Our London Correspondent

A RECENT conference on oil shales and cannel coals, arranged by the Institution of Petroleum Technologists at Glasgow, has given a rather hopeful outlook to the revival on more prosperous lines of these once notable industries in Scotland and in certain parts of England. A greater utilization of cannel is highly desirable in view of the fact that large deposits are available for mining but only between 700 and 800 tons constituted the total Scottish production in 1935, whereas 322,000 tons were produced in 1865, at a time when there was much more individual enterprise and fewer "schemes" based upon theory and minor laboratory experiments in this country. Oil shale, likewise, has been produced in much smaller quantities, having been less than 1½ million tons in 1937, whereas it was 423,000 tons in 1865, and reached a peak of nearly 3 million tons under stress of war-time circumstances in 1915.

One of the papers presented at the conference pointed out that attempts are being made to apply the modern processes of cracking, hydrogenation and synthetic oil production from water gas, to the shale oil industry. On the Continent it has been shown that cracking can convert shale oils into products which are similar to those obtained by the cracking of petroleum. In consequence, shale oil represents a large potential source of motor fuel, far larger than the present production which, according to figures officially quoted in Parliament, was only 7½ million gallons during 1937, together with 14½ million gallons of diesel oil.

Another paper dealt especially with the hydrogenation of shale oil for the production of motor spirit. The treatment

of shale oil in the liquid phase, with a finely-divided catalyst, has been the subject of lengthy experiments, which have now proved that the conversion of the heavy fractions in the middle oil resulting from the distillation of oil shale can be carried out easily with high yields, and that liquid phase middle oil from paraffinic shale oil can be employed direct as diesel oil. A new method of distilling shale was described, distillation being effected in principal by recycling part of the products of distillation through a heater and thence back again through the mass of shale in the distillation zone of the retorting equipment.

An educational bureau to provide information upon the use of iodine in agricultural, medical and industrial fields, has been established in London by the Nitrate Corporation of Chile, Ltd. The bureau will collaborate with scientific institutions throughout the world in experimental research to extend present-day knowledge of the properties and possible uses for both small and large quantities of iodine. Extended research and propaganda for rubber is being contemplated by the British Rubber Producers' Research Association and the British Rubber Publicity Association.

At the forthcoming meeting of the British Association for the Advancement of Science, which will be held at Cambridge, August 17 to 24, the president of the Chemistry Section, Prof. C. S. Gibson, will review recent advances which have been made in the chemistry of gold. Repercussions of synthetic organic chemistry on biology and medicine will be the subject of a special symposium, in the course of which new knowledge will be given upon hormones, vitamin B and analogous compounds, and cancer-pro-

ducing chemicals of synthetic origin.

Recent industrial developments include a notable amalgamation of Rickett & Sons, Ltd., and J. & J. Colman, Ltd., both of whom are large producers of starch and related products. W. J. Bush & Co., Ltd., of London, has just opened a new works extension for the production of natural fruit juice products. The equipment and methods of processing have been so selected that products free from yeast and bacterial contamination are ensured, and at the same time the natural vitamin content of the fruit is preserved and there is negligible alteration in natural sugars and mineral constituents.

Investigations into the causes and prevention of the corrosion of tar stills, the result of work carried out at the National Chemical Research Laboratory on behalf of the Association of Tar Distillers, have just been published as a special report of the Department of Scientific and Industrial Research. The urgency of this problem is emphasized by the statement that the consequent reduction in the life of a tar still by 50 per cent was equivalent to an addition of 5 pence per ton of tar distilled and the total cost to the tar industry was of the order of £25,000 annually. This report also states that it is difficult to visualize any chemical treatment of tar which will neutralize or destroy the corrosive tendencies of resins, which predominate in low temperature tars but are practically absent in coke oven and horizontal retort tars and present to an intermediate degree in the case of vertical retort tars. These resins, upon which the corrosive effect of any tar is chiefly dependent, are noncrystalline portions of the tar soluble in caustic soda. Also relating to tar is the revision of the British Standards Specification for sampling coal tar and its products. This specification (No. 616) was originally published in 1935 and has now been completely revised, special attention being given to the sampling of pitch and such products as phenols and benzols which are placed on the market in a refined state.

Comparison of United States production and sales of dyes, by classes of application, 1925-30, 1936 and 1937

Class of application	Production			Sales		
	1925-30 average Pounds	1936 Pounds	1937 Pounds	1925-30 average Pounds	1936 Pounds	1937 Pounds
Acid.....	11,813,941	15,974,423	15,319,063	11,699,667	15,528,825	14,889,674
Azoic.....	1	1	12,699,643	1	1	12,391,318
Basic.....	4,833,382	5,727,303	5,775,239	4,709,926	5,465,227	5,433,966
Direct.....	17,983,751	29,907,629	30,619,424	17,580,927	29,495,273	29,174,099
Acetate silk.....	4	2,389,885	2,191,881	4	1,943,406	2,099,587
Lake and spirit-soluble.....	1,947,124	2,722,807	3,157,406	1,896,821	2,624,777	2,949,908
Mordant and chrome.....	3,611,608	6,639,112	6,192,888	3,558,732	6,234,937	6,008,996
Sulfur.....	20,004,635	20,717,289	20,528,542	19,810,565	20,812,369	20,455,232
Yat, Total.....	33,221,072	34,449,513	34,501,413	32,429,018	34,553,262	33,476,528
(a) Indigo.....	27,128,311	18,039,419	24,842,627	27,111,575	17,848,853	24,483,205
(b) Other.....	6,092,761	16,410,094	9,658,786	5,317,443	16,708,409	8,923,323
Unclassified.....	587,657	995,185	1,259,080	521,625	910,747	1,236,819
Total.....	94,003,170	119,523,146	122,244,579	92,207,281	117,572,823	118,046,127

<sup>1</sup> Not shown separately prior to 1937.

<sup>2</sup> Includes rapid fast and rapidogen dyes and their components, fast color salts and naphthol AS derivatives.

<sup>3</sup> Includes rapid fast dyes and rapidogen dyes.

<sup>4</sup> Not shown separately during 1925-30.



## INCREASE IN COMSUMPTION UPSETS GERMANY'S PLAN FOR SELF SUFFICIENCY IN MOTOR FUELS

From Our German Correspondent

**E**IGHTEEN months have elapsed since Adolf Hitler predicted that Germany would be independent of motor fuel imports within a year and a half. The Reich's large import balance of petroleum products shows, however, that this goal has not been achieved. This has been partly because of increased consumption by the unexpectedly larger number of motor vehicles and partly because military considerations have probably accounted for a larger share of fuel consumed by the army or stored as reserves. Then, too, synthetic production of gasoline had been handicapped by technical problems, high costs of operation of plants, and the large investment required, obstacles which have been partly overcome through direct and indirect government subsidy.

It took a full year to complete the most recently opened synthetic gasoline plant of the Stinnes-controlled Ruhröl G.m.b.H. This plant, the first to be completed under the second Four-Year Plan economy, produces gasoline, diesel and special heating oils using a combination of the I.G. high pressure and Pott-Broche extraction processes. Aside from more economical operation, it is claimed that the newest plant will be in an advantageous position since it can also treat tar and other heretofore unmarketable byproducts resulting from Germany's increased coke output.

The German army—the proving ground for synthetic rubber and motor fuels—is now experimenting with changes in the construction of automobile motors to utilize gasolines of lower octane ratings than those used in the past. With the compulsory admixture of methyl and ethyl alcohols ("Treibsprit") with gasolines, they have all had excellent anti-knock qualities. The mixture was changed last year, and the present standard brands have octane ratings of 74-76 for gasoline and 78-82 for benzine benzol mixtures. It is hoped to design motors that will run satisfactorily with a standard 74 octane rating gasoline to be sold uniformly throughout the Reich.

Simultaneously with the efforts to economize in the consumption of existing motor fuels, increased attention is being paid to the possibilities of operating heavier vehicles directly with the raw materials, wood, coal, and gas. Wood and charcoal gas generators for motors are past the experimental stage, and runs of 20,000 to 40,000 kw. without any mechanical difficulties are reported. Peat

coke, with properties similar to charcoal, also looks to be a promising source of fuel. Coal coke has presented considerable difficulties, however, chiefly because of the large ash residue and slag formation, which is three times higher for brown coal than for hard coal. The impurities, especially sulphur, in the gas generated from brown coal, or lignite, and peat coke attack cylinder walls, valves, and fuel lines in spite of apparatus to purify the gas. Cleaning the raw fuel beforehand complicates and increases the cost of operation. A number of the latest gas purifiers and generator types are to be tested in a hundred cars and trucks on cross-country runs by the army, and it is hoped soon to achieve a simplification in construction and more satisfactory operation.

### Heavy Motors Developed

Heavy motors that will run with either diesel oil or gas are being developed. Operation with generator gas, however, entails a 5 to 25 per cent loss of power and requires certain special adjustments in the mixture of fuel and air. In 1937, 38 per cent of all trucks over two tons in Germany were operated with diesel engines.

Whereas the diesel engine is steadily replacing other types in the heavier commercial vehicle classes, in medium weight trucks of two to three tons, greater progress has been made by compressed liquid gas types. Their ratio of trucks over two tons grew from 0.5 per cent to 6 per cent from 1936 to 1937 and will be still larger by the end of this year. The use of liquid gas for trucks is hardly four years old in Germany, the first vehicles of this type being developed and operated by the Concordia mining company in the Ruhr. In 1934 there were only 50 trucks in the Ruhr running with this type of gas. Today there are over 2,500 in the Ruhr industrial district alone and 12,000 all over Germany. By the end of 1938 another 10,000 should be in operation.

The liquid gas is similar to regular gasoline from the combustion standpoint after it leaves the carburetor. Consisting chiefly of propane, butane, propylene and butylene, the liquid gas is marketed as "Treibgas" by three distributors, I. G. Farben, Deurag, and the west German Benzol-Verband. While this gas is used in the U. S. more for industrial and household purposes, in the Reich it

has been used so far almost exclusively as a motor fuel. The vapors are not poisonous and do not attack metals, and they are nearly odorless. No materials are added as in America to make the odor more easily apparent in case of leaks.

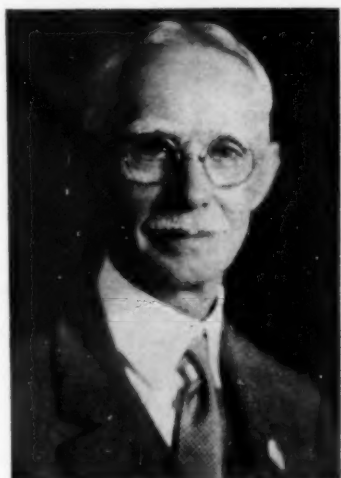
The source of the liquid gas which is gaining ground so rapidly in Germany as a motor fuel is not natural gas as in the U. S.—although a small amount is produced from this source in Hännigsen in the Hanover petroleum area—but as a byproduct comprising 10 per cent of the output of synthetic gasoline plants. When the present projected hydrogenation plants are completed, they should turn out at least 150,000 tons of "Treibgas" yearly on the side. Further possible sources of the new motor fuel are petroleum cracking and refining plants and low temperature brown and hard coal coking processes and coke gases. Separating the gasoline and stabilizing the gas is accomplished either by compression, with or without additional low temperatures, washing under pressure with oils, or through absorption with the aid of active carbon, the latter process being of considerable importance in Germany.

After extensive operating tests it is reported that the mileage run with "Treibgas" is about the same as with the equivalent amount of gasoline by weight. The octane ratings vary between 100 and 110 according to the mixture of propane, propylene, butylene, and the butanes, with the octane ratings declining in the order mentioned.

The advantages claimed for the compressed gas are as follows: (1) gaseous form makes starting easier in cold weather, (2) mixes well with air and gives complete and economical combustion, (3) combustion is odorless and smokeless, (4) no residue deposited on pistons, spark plugs, and valves, (5) no dilution of motor oil.

The disadvantages are the inconvenience, greater complication before carburetion, and the weight and space taken up by the containers for the gas which must be carried on the side of the truck. The gas is contained in seamless steel cylinders of three standard sizes with a capacity of 22 kg., 33 kg., or 46 kg. for the I.G., Deurag, and B.V. gases, respectively, and the containers remain the property of the manufacturer and are loaned free of charge to the consumer. The latter type cylinder when filled with 46 kg., or 109 liters, of compressed gas, weighs about 99 kg. and is about 4½ feet long.

The cost of installing the gas apparatus on gasoline engine trucks already in operation is uniformly fixed at only 400 RM. To encourage the use of this domestic motor fuel the tax on trucks using it was reduced by approximately 50 per cent in 1935, and the price of the gas has been set at 15 per cent below that for the equivalent weight of gasoline.



Charles Holmes Herty

♦ CHARLES HOLMES HERTY, known throughout the country for his contributions to the technical development of the American turpentine industry and his more recent adaptation of Southern pine to the making of newsprint, rayon and other cellulose products, died of a heart ailment, July 27, in Savannah, Ga.

A true son of the South, Dr. Herty was born at Milledgeville, Ga., on December 4, 1867, was educated at the University of Georgia, Johns Hopkins, Berlin and Zurich, and taught chemistry for a time at the University of Georgia and the University of North Carolina.

From 1917 to 1921 he served as editor of *Industrial and Engineering Chemistry* and for the next five years was president of the Synthetic Organic Chemical Manufacturers Association. Since 1926 he has been adviser to the Chemical Foundation, Inc. He was elected to the presidency of the American Chemical Society in 1915, and was honored in 1932 with the gold medal of the American Institute of Chemists and in 1934 with the American Chemical Society's Herty Medal, named for him.

Dr. Herty was recognized as an outstanding industrial chemist of the present day.

♦ WILLIAM A. COWAN retired on July 1 from his position as assistant chief chemist of the National Lead Co. laboratories in Brooklyn, N. Y.

♦ L. JUNIUS DESHA has become permanent head of the department of chemistry at Washington and Lee University.

♦ GUSTAV EGLOFF, director of research of Universal Oil Products Co., Chicago, recently received the honorary degree of Doctor of Science from the Polytechnic Institute of Brooklyn.

♦ ALFRED W. FLEER has been appointed assistant professor of chemical engineer-

ing at the University of Virginia. Dr. Fleer is at present chemical engineer and petroleum technologist in the design and development division of Shell Petroleum Corp., St. Louis. He will begin his duties at Virginia in September.

♦ JAMES LEWIS HOWE, professor of chemistry at Washington and Lee University since 1894, has been made historian of that university and professor emeritus of chemistry.

♦ RAYMOND LYNN PATTERSON has been elected vice-president in charge of development of the Hardy Metallurgical Co., New York City.

♦ OSCAR SWENSON, formerly chemical engineer in the industrial engineering division of E. I. du Pont de Nemours & Co., has been appointed assistant professor of chemical engineering at Cornell University. According to President Edmund E. Day, Dr. Swenson's appointment completes the organization of the faculty for the new Cornell School of Chemical Engineering, which was officially inaugurated on July 1.

♦ WESLEY P. SYKES, metallurgical engineer at the Cleveland Wire Works of the General Electric Co., was awarded the honorary degree of Doctor of Engineering by the Case School of Applied Science.

♦ LOUIS WILPUTTE, president of the Wilputte Coke Oven Corp., New York City, is in Europe touring England and the continent to observe recent developments in coke oven construction abroad.

♦ D. F. WOOD, traffic manager of Binney & Smith Co. for the past 21 years,

retired on July 1 and has been succeeded by C. D. Macknee.

♦ CARL ZAPFFE, JR., formerly in the metallurgical division of E. I. du Pont de Nemours & Co., has been appointed research associate at Battelle Memorial Institute, Columbus, Ohio. He has been assigned to an investigation of the solubility of oxides in liquid iron and steel.

## OBITUARY

♦ C. W. GRAY, chemical consultant in the field of distilled spirits, died at his home in Norwalk, Conn., on May 28. Dr. Gray was formerly distillery engineer for Ford, Bacon & Davis Co., New York City.

♦ R. E. HAYLETT, director of manufacturing and member of the board of directors of the Union Oil Co., Los Angeles, Calif., died June 13, after a brief illness. Mr. Haylett was chairman of the central committee on refinery technology of the American Petroleum Institute.

♦ WILLIAM TRACY HINCKLEY, vice president of the Swenson Evaporator Co., Harvey, Ill., died at Bogalusa, La., on July 11 as the result of a broken vertebrae incurred while swimming.

♦ G. M. JOHNSTONE MACKAY, director of research at the laboratories of the American Cyanamid Co. at Stamford, Conn., died July 29 after an attack of pleural pneumonia. He was 55 years old.

♦ FRANK J. TUIITE, for more than 25 years a member of the engineering and sales department of the Robins Conveying Belt Co., New York City, died on July 20.

## CALENDAR

SEPT. 5-9, AMERICAN CHEMICAL SOCIETY, Milwaukee, Wis.

SEPT. 8-10, TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY, semi-annual meeting, Green Bay, Wis.

OCT. 12-15, ELECTROCHEMICAL SOCIETY, Hotel Seneca, Rochester, N. Y.

NOV. 9-11, AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, annual meeting, Benjamin Franklin Hotel, Philadelphia, Pa.

DEC. 5-10, THIRTEENTH NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING, Grand Central Palace, New York City.

APRIL 16-21, 1939, AMERICAN CERAMIC SOCIETY, Hotel Stevens, Chicago, Ill.

# Chemical ECONOMICS and MARKETS

## CONSUMPTION OF CHEMICALS SHOWED MARKED RISE LAST MONTH

**D**IFFERENT consuming industries have enlarged their scope of manufacturing operations in the last month and have been taking on larger supplies of chemicals and other raw materials. Textiles and leather appear to have set the pace in the upward movement but some branches of the glass industry, tire manufacturers, iron and steel producers also have shown expansion and consumption of chemicals in July is estimated to have run about 12 per cent in excess of the May total.

Production of chemicals, on the other hand, has not moved up in a corresponding way although the trend in some branches of the producing end has been upward with further acceleration anticipated for the present month. A typical explanation for the difference in rate of production and consumption of chemicals is illustrated in the case of rayon where shipments of yarn were made at the highest daily rate in the history of the industry yet, because of the large stocks in producers' hands, there was practically no change in output of yarn. The increase in stocks from Jan. 1 to June 30, however, was practically wiped out by the July excess of shipments over production.

The Federal Reserve Board's seasonally adjusted index for industrial production rose from 77 in June to "80 or more" for July, according to the board's study of business conditions. The index was at 76 in May.

Among the favorable findings of the study were that recent reductions in prices of basic materials should encourage expenditures for capital equipment when conditions warrant such outlays; reduced costs found to be one of the active stimulants in the home building field; and the recent cut in steel inventories an important factor leading to increase in steel output.

The recent improvement follows a period of five months when industrial activity was declining gradually and when inventory reductions were continuing in substantial amounts. Currently inventory positions appear distinctly smaller in many lines, such as automobiles, steel and textiles. The situation is not uni-

form, however, stocks of some commodities, particularly raw materials, continuing large. The reduction in inventories occurred notwithstanding some decline in distribution of commodities.

The bulletin reported that manufacturers had acquired considerable inventories of steel late in 1937 so that much of the steel which entered into production in recent months came from stocks. Thus, steel consumption was considerably above production.

Manufacturers' sales during the first half of 1938 were 24.5 per cent below the first six months of 1937 according to a special analysis of reports from 800 firms reporting sales data for both years to the Marketing Research Division of the Bureau of Foreign and Domestic Commerce.

The Association of Soap & Glycerine Manufacturers, Inc. has reported that sales of soap for the second quarter of this year increased 18.1 per cent in tonnage and 10.8 per cent in sales value as compared with the corresponding period of last year. One of the large soap com-

panies in its report for the first half of this year stated that sales volume has been holding at an excellent level close to a year ago and reports indicate that dealers who have been buying from hand to mouth have very low inventories. Consequently it is likely that volume in the final half of the year will be at least as large as in the first six months and should be considerably better if business improvement develops.

In the first quarter of this year, sales of soap, not including liquid soap, amounted to 675,554,534 lb. while sales in the second quarter were 655,735,088 lb. Hence there was a falling off in sales during the second quarter.

Manufacture of paper has disregarded seasonal influences and has shown a rising trend from about the middle of June. Paperboard output, with the exception of the week beginning July 4, has risen notably and records the highest rate for the industry.

While a fairly general improvement in business started in the latter part of June, the accompanying tabulation clearly reveals that the first half of this year saw a sharp drop in operations in the industries which offer the largest outlets for chemicals. With the exception of petroleum refining, all the principal chemical-consuming industries fell far below the levels reached in the first half of 1937. Plate glass production records the sharpest drop for the period but window glass manufacture also made a very unfavorable showing with a percentage decline of 67, the figures being 2,816,774 boxes in the 1938 period and 6,459,657 boxes in 1937.

Automotive production fell steadily and had a far-reaching influence upon the sales of chemicals, plastics, lacquers, rubber, steel, and many other commodities.

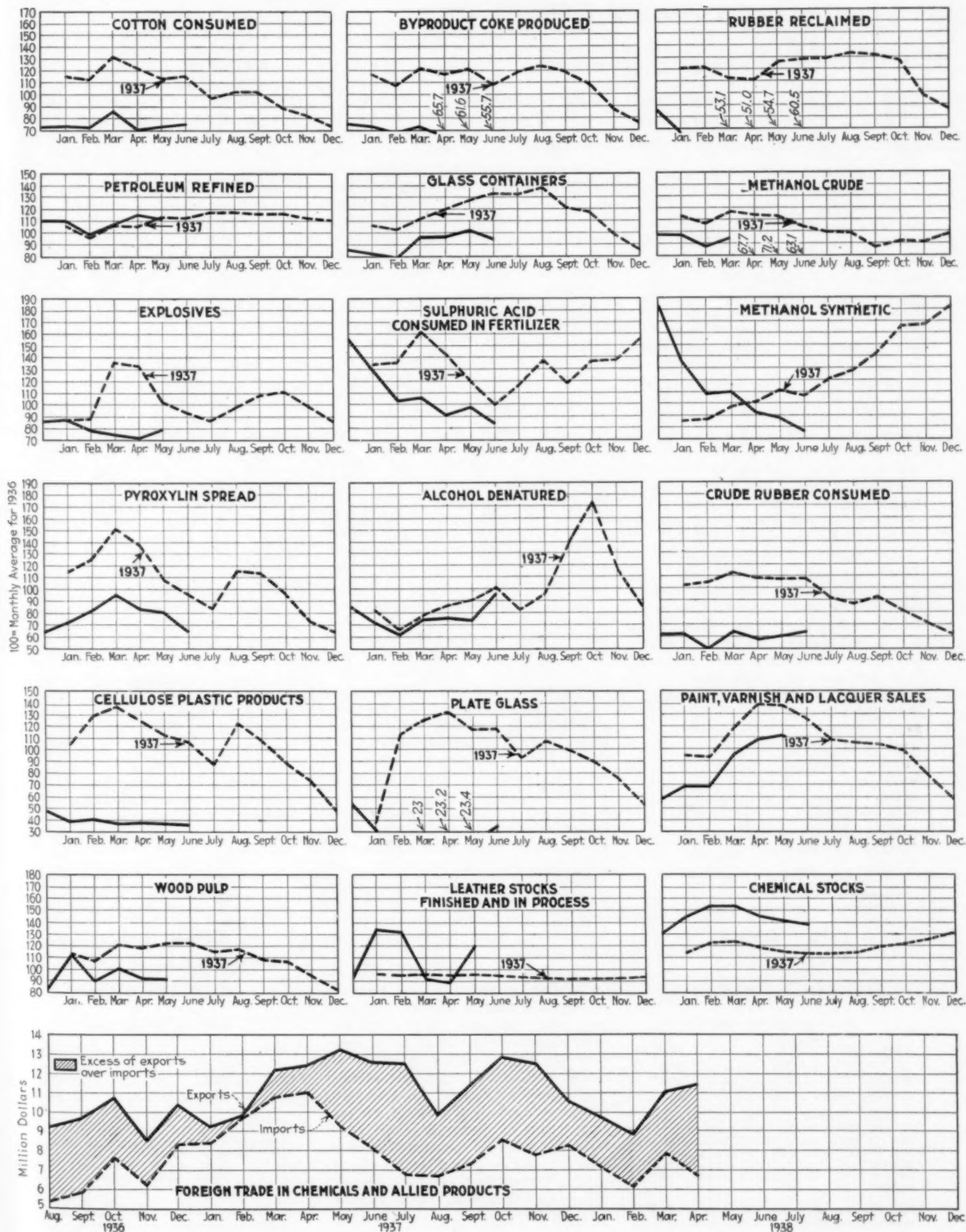
Production and Consumption for Chemical-Consuming Industries

	June 1938	June 1937	Jan.-June 1938	Jan.-June 1937	Per cent of decline for 1938
<b>PRODUCTION</b>					
Alcohol, ethyl, 1000 pr. gal. ....	16,395	18,658	94,221	108,571	13.2
Alcohol, denatured, 1000 wi. gal. ....	7,870	8,320	37,433	41,691	10.2
Benzol, 1000 gal. ....	4,413	9,517	32,431	60,921	46.7
Byproduct coke, 1000 tons. ....	2,067	4,024	14,717	25,695	42.3
Glass containers, 1000 gr. ....	3,583	4,980	20,824	26,493	21.4
Plate glass, 1000 sq. ft. ....	5,956	19,392	25,227	106,577	76.3
Methanol, crude, gal. ....	293,091	485,943	2,238,707	3,113,048	28.1
Methanol, synthetic, gal. ....	1,629,570	2,263,507	12,997,300	12,512,763	3.8*
Pyroxylin spread, 1000 lb. ....	3,355	4,958	24,319	37,935	35.8
Rubber reclaimed, tons. ....	7,584	16,052	41,401	90,508	54.2
Rosin, wood, bbl. ....	40,866	63,428	277,222	367,204	24.5
Turpentine, wood, bbl. ....	6,594	9,208	43,230	57,218	24.4
Steel barrels, heavy, No. ....	696,528	923,049	3,917,088	5,310,878	26.2
Steel barrels, light, No. ....	156,752	180,175	910,238	1,156,348	21.3
Sulphuric acid, in fertilizer trade, tons	114,199	154,275	893,264	1,060,408	15.8
<b>CONSUMPTION</b>					
Cotton, 1000 bales. ....	443	681	2,656	4,191	36.6
Silk, bales. ....	31,492	35,783	180,410	234,238	19.1
Wool, 1000 lb. ....	18,780	29,592	97,905	213,619	54.2
Explosives, 1000 lb. ....	25,445	29,327	149,096	202,174	26.3
Sulphuric acid in fertilizer, tons. ....	102,228	121,716	733,912	966,287	24.0

\* Per cent of increase.



# Production and Consumption Trends



## GREATER BUYING INTEREST SHOWN IN MARKET FOR CHEMICAL PRODUCTS

**B**UYING interest in chemicals has been of a more encouraging nature in recent weeks and in many cases this has been reflected in a larger tonnage movement. With production on a fairly stable basis, deliveries in many instances have run ahead of output and it has been necessary to draw upon stocks with a lowering in producer's inventories. Reports from many of the chemical-consuming industries have indicated a broadening of manufacturing operations and since the turn of the month, a better trading movement has been experienced with a fairly general expectation that buying orders will gain considerable acceleration in the later months of the year.

Weevil infestation in some parts of the cotton-growing sections has brought a better call for calcium arsenate with reports that the seasonal movement of this chemical has been of normal proportions. Copper sulphate stocks have been held to low levels with demand and supply holding closely together.

The price trend for chemicals last month was again downward with the solvent group figuring prominently in the downward movement. Some of the solvents appear to be suffering from the fact that large consumers are covered ahead and other consuming demand has not been developed to a point where it is commensurate with productive capacity. Stocks of a few of the basic chemicals have given some worry to producers and stand in the way of firm prices for those particular products. The majority of heavy chemicals, however, have maintained a steady price position which has been strengthened by the outlook for larger distribution in the near future.

Prices for vegetable oils and fats

showed further hardening throughout the last month with consumption holding up well, particularly in the case of edible oils. The government estimate of 11,988,000 for the cotton crop was larger than had been generally anticipated and may have a temporary effect on quotations for cottonseed oil but in view of currently large consumption of this oil, the prospective supply of seed for crushing purposes does not seem to carry bearish significance.

The drop in automotive production this year has been reflected in the slower call for lacquers. Sales of paints, varnishes, and lacquers for June have just been made public and the report places sales at \$33,936,706 which compares with \$41,656,085 for June last year. For the first six months, sales this year were valued at \$180,965,715 or about 23 per cent below the like 1937 total. Sales of lacquer for the six-month period amounted to \$16,605,598 or nearly 34 per cent below the corresponding period of 1937. The larger percentage decline in the case of lacquers may be largely attributed to the curtailed market in the automotive trade.

Manufacturers of plastics have been more active in the last few weeks but had cut down sharply in their consumption of raw materials in the first six months of the year. Production of cellulose acetate sheets, rods, and tubes for the first half of this year reached a total of 1,645,842 lb. compared with 7,437,600 lb. in the corresponding period last year. Production of nitrocellulose products for the same periods was 4,045,731 lb. and 10,340,212 lb. respectively.

Naval stores regulations have been very extensively revised by the Food and Drug Administration which handles matters of inspection, sampling, standards, and classification or grading. Producers, marketers, and users will require new issue of Service and Regulatory Announcements, Naval Stores No. 1, for their guidance.

Colored glaze hazards have been noted by Government officials in some types of ceramic tableware, in brilliant reds, yellows, greens and blues. A test with hot white redistilled vinegar on such ware often discloses significant quantities of soluble lead. A standard test of this type is urged by officials. Any glaze dissolving as much as 2 parts of Pb per million parts of vinegar is considered a hazard to health. Pigment and ceramic users are being warned of the importance of these matters by Government officials. Seizures of "dangerous" ware may be expected.

In connection with tung oil a recent report to the Department of Commerce stated that tung oil continued to be re-exported from Hong Kong in fair quantities in June during which month a total of 5,804,000 lb. was shipped to the United States and 401,600 lb. to Europe. In April, that port reexported a total of 8,912,400 lb. of Chinese tung oil—7,071,000 lb. of which being destined for the United States and the remainder to different countries in Europe.

All of the tung oil reexported from Hong Kong originates in South and Central China, chiefly the latter area. At the end of June stocks of oil on hand at Hong Kong available for reexport were reported as being small—probably not more than 1,000 short tons. The report, however, stated that stocks at that time were ample and that fair quantities were continuing to arrive from South and Central China.

With the exception of relatively small quantities of tung oil now being produced in Gulf Coast States, all of the tung oil consumed by American manufacturers of varnish, linoleum, oilcloth, printing ink, and other industries, originates in China. According to growers, Gulf Coast states will produce close to 20,000,000 lb. of tung nuts during the current year, which estimates indicate should yield 4,000,000 lb. of oil.

Preliminary reports on the domestic flaxseed crop indicate a slight increase in acreage and probably a larger out-turn of seed but the crop at best can hold out promise of filling only a small part of domestic crushing requirements. The hope that California might take its place among the leading producing states was dimmed when the acreage figures for this season showed a drop from the total seeded last year although a high yield per acre is anticipated for that section. It is now reported that experiments with growing flax in Texas have been encouraging and that a large area in that state may go into flax for next season.

### CHEM. & MET.

#### Weighted Index of CHEMICAL PRICES

Base = 100 for 1935

This month.....	99.22
Last month.....	99.68
August, 1937.....	102.27
August, 1936.....	98.80

Keen competition has weakened values for solvents and lower prices for the latter were mainly responsible for the decline in the weighted index number. Copper sulphate was prominent among the chemicals which were higher.

### CHEM. & MET.

#### Weighted Index of Prices for OILS AND FATS

Base = 100 for 1935

This month.....	82.97
Last month.....	79.68
August, 1937.....	98.63
August, 1936.....	90.58

Animal fats were higher in price and most of the vegetable oils also were marked up in price with linseed oil offering an exception. Uncertainty about China wood shipments has brought about higher prices for spot and shipment.



# INDUSTRIAL CHEMICALS

	Current Price	Last Month	Last Year
Acetone, drums, lb.	\$0.051-\$0.061	\$0.051-\$0.061	\$0.06-\$0.07
Acid, acetic, 28%, bbl, cwt.	2.23-2.48	2.23-2.48	2.53-2.78
Glacial 99%, drums	8.43-8.68	8.43-8.68	8.70-8.95
U. S. P. reagent	10.25-10.50	10.25-10.50	10.75-11.00
Boric, bbl, ton.	106.00-111.00	106.00-111.00	105.00-115.00
Citric, kegs, lb.	.231-.25	.231-.25	.25-.28
Formic, bbl, ton.	.101-.11	.101-.11	.11-.111
Gallie, tech., bbl, lb.	.70-.75	.75-.78	.60-.65
Hydrofluoric 30% carb., lb.	.07-.071	.07-.071	.07-.071
Lactic, 44%, tech., light, bbl, lb.	.061-.061	.061-.061	.61-.61
Muriatic, 18", tanks, cwt.	1.05-1.05	1.05-1.05	1.05-1.05
Nitric, 36", carboys, lb.	.05-.051	.05-.051	.05-.051
Oleum, tanks, wks, ton.	18.50-20.00	18.50-20.00	18.50-20.00
Oxalic, crystals, bbl, lb.	.101-.12	.101-.12	.101-.12
Phosphoric, tech., c' bys, lb.	.09-.10	.09-.10	.09-.10
Sulphuric, 60", tanks, ton.	13.00-13.00	13.00-13.00	13.00-13.00
Sulphuric, 66", tanks, ton.	16.50-16.50	16.50-16.50	16.50-16.50
Tannic, tech., bbl, lb.	.40-.45	.40-.45	.40-.45
Tartaric, powd., bbl, lb.	.271-.271	.271-.271	.271-.271
Tungstic, bbl, lb.	2.75-2.75	2.75-2.75	2.75-2.75
Alcohol, Amyl.	1.06-1.06	1.23-1.23	1.06-1.06
From Pentane, tanks, lb.	.081-.081	.081-.081	.081-.081
Alcohol, Butyl, tanks, lb.	4.581-4.581	4.581-4.581	4.14-4.14
Alcohol, Ethyl, 190p't, bbl, gal.	29-.29	.31-.31	.34-.34
Denatured, 190 proof	.031-.04	.031-.04	.03-.04
No. 1 special, dr., gal wks.	.15-1.40	.15-1.40	1.35-1.50
Alum, ammonia, lump, bbl, lb.	1.30-1.55	1.30-1.55	2.00-2.25
Potash, lump, bbl, lb.	.021-.03	.021-.03	.021-.03
Aluminum sulphate, com bags, cwt.	.021-.021	.021-.021	.021-.021
Iron free, kg., cwt.	.151-.151	.151-.151	.151-.151
Aqua ammonia, 26", drums, lb.	.041-.041	.041-.041	.041-.041
tanks, lb.	.08-.12	.08-.12	.08-.12
Ammonia, anhydrous, cyl, lb.	1.325-1.325	1.325-1.325	1.425-1.425
Ammonium carbonate, powd, tech., caaka, lb.	.11-.12	.11-.12	.11-.111
Sulphate, wks, cwt.	.111-.12	.111-.12	.151-.16
Amylacetate tech., tanks, lb.	.03-.031	.03-.031	.03-.031
Antimony Oxide, bbl, lb.	.151-.16	.151-.16	.151-.16
Arsenic, white, powd., bbl, lb.	52.50-57.50	52.50-57.50	52.50-57.50
Red, powd., kegs, lb.	79.00-81.00	79.00-81.00	79.00-81.00
Barium carbonate, bbl, ton.	.07-.08	.07-.08	.07-.08
Chloride, bbl, ton.	.031-.04	.031-.04	.031-.04
Nitrate, caak, lb.	2.00-2.10	2.00-2.10	2.00-2.10
Blanc fixe, dry, bbl, lb.	48.00-51.00	48.00-51.00	46.00-51.00
Bleaching powder, f. o. b. wks, drums, cwt.	.30-.32	.30-.32	.36-.38
Borax, gran., bags, ton.	1.65-1.65	1.65-1.65	2.25-2.25
Bromine, ca., lb.	.061-.07	.061-.07	.061-.07
Calcium acetate, bags	.05-.06	.05-.06	.05-.06
Arsenate, dr., lb.	21.50-24.50	21.50-24.50	20.00-33.00
Carbide drums, lb.	23.00-25.00	23.00-25.00	22.00-35.00
Chloride, fused, dr., del., ton.	.071-.08	.071-.08	.071-.08
flake, dr., del., ton.	.05-.06	.05-.06	.051-.06
Phosphate, bbl, lb.	.051-.06	.051-.06	.051-.06
Carbon bisulphide, drums, lb.	2.15-2.15	2.15-2.15	2.15-2.15
Tetrachloride drums, lb.	.051-.06	.051-.06	.051-.06
Chlorine, liquid, tanks, wks, lb.	.051-.06	.051-.06	.051-.06
Cylinders	1.67-1.70	1.67-1.70	1.67-1.70
Cobalt oxide, caak, lb.	15.00-16.00	15.00-16.00	15.00-16.00
Coppers, bags, f.o.b. wks, ton.	.09-.161	.09-.161	.101-.191
Copper carbonate, bbl, lb.	4.25-4.50	4.15-4.40	5.15-5.40
Sulphate, bbl, cwt.	.211-.22	.211-.22	.181-.19
Cream of tartar, bbl, lb.	.22-.23	.22-.23	.22-.23
Diethylene glycol, dr., lb.	1.80-2.00	1.80-2.00	1.80-2.00
Epom salt, dom., tech., bbl, cwt.	.061-.061	.071-.071	.071-.071
Ethyl acetate, drums, lb.	.051-.061	.051-.061	.051-.061
Formaldehyde, 40%, bbl, lb.	.10-.171	.10-.171	.10-.171
Furfural, dr., lb.	.121-.14	.16-.18	.16-.18
Fusel oil, ref. drums, lb.	.95-1.00	.95-1.00	.85-1.00
Glauber salt, bags, cwt.	.161-.161	.161-.161	.231-.231
Glycerine, c.p., drums, extra, lb.	.061-.061	.061-.061	.071-.071
Lead:	.06-.06	.06-.06	.071-.071
White, basic carbonate, dry caaka, lb.	.071-.071	.071-.071	.071-.071
White, basic sulphate, sek., lb.	.071-.071	.071-.071	.071-.071
Red, dry, sek, lb.	.10-.11	.10-.11	.131-.14
Lead acetate, white crys., bbl, lb.	.121-.13	.13-.131	.111-.12
Lead arsenate, powd., bbl, lb.	8.50-8.50	8.50-8.50	8.50-8.50
Lime, chem., bulk, ton.	.061-.061	.061-.061	.081-.081
Litharge, powd., caak, lb.	.041-.041	.041-.041	.041-.05
Lithophone, bags, lb.	.06-.061	.06-.061	.06-.061
Magnesium carb., tech., bags, lb.			

The accompanying prices refer to round lots in the New York market. Where it is the trade custom to sell f.o.b. works, quotations are given on that basis and are so designated. Prices are corrected to Aug. 12

## Current PRICES

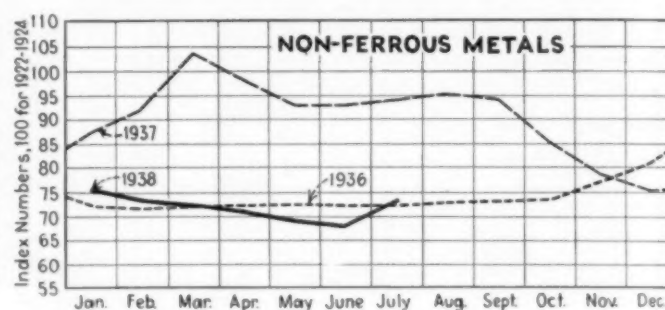
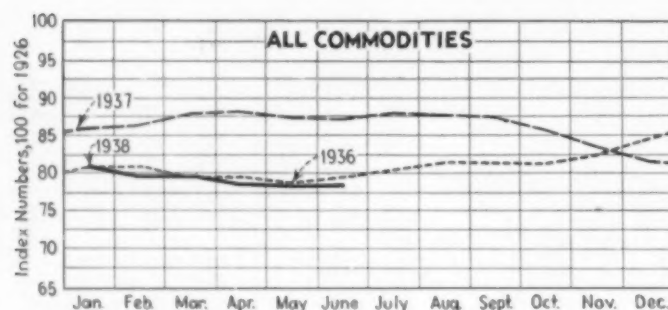
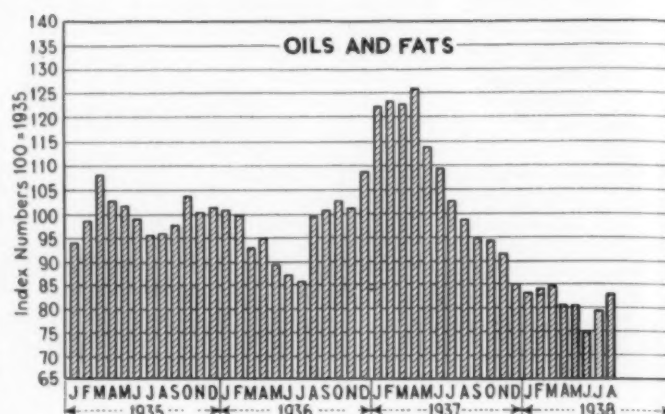
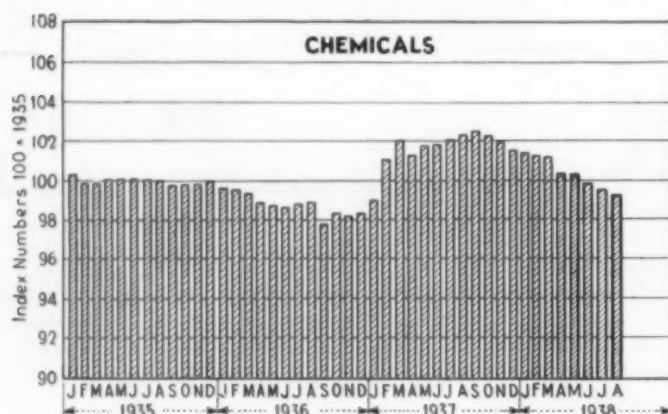
	Current Price	Last Month	Last Year
Methanol, 95%, tanks, gal.	.31-.31	.31-.31	.31-.31
97%, tanks, gal.	.32-.32	.32-.32	.32-.32
Synthetic, tanks, gal.	.33-.33	.33-.33	.33-.33
Nickel salt, double, bbl, lb.	.13-.131	.13-.131	.13-.131
Orange mineral, caak, lb.	.101-.101	.101-.101	.12-.12
Phosphorus, red, caas, lb.	.40-.42	.40-.42	.40-.42
Yellow, caas, lb.	.24-.30	.24-.30	.24-.30
Potassium bichromate, caaka, lb.	.081-.09	.081-.09	.081-.09
Carbonate, 80-85%, caak, csk.	.051-.06	.051-.06	.061-.07
Chlorate, powd., lb.	.091-.091	.091-.091	.091-.091
Hydroxide (caustic potash) dr., lb.	.07-.071	.07-.071	.07-.071
Muriate, 80% bgs, unit.	.531-.531	.531-.531	.531-.531
Nitrate, bbl, lb.	.051-.06	.051-.06	.051-.06
Permanganate, drums, lb.	.181-.19	.181-.19	.181-.19
Prussate, yellow, caaka, lb.	.15-.16	.15-.16	.15-.16
Sal ammoniac, white, caaka, lb.	.05-.051	.05-.051	.05-.051
Sal soda, bbl, cwt.	1.00-1.05	1.00-1.05	1.00-1.05
Salt cake, bulk, ton.	13.00-15.00	13.00-15.00	13.00-15.00
Soda ash, light, 58%, bags, contract, cwt.	1.23-1.23	1.23-1.23	1.23-1.23
Dense, bags, cwt.	1.25-1.25	1.25-1.25	1.25-1.25
Soda, caustic, 76%, solid, drums, contract, cwt.	2.60-3.00	2.60-3.00	2.60-3.00
Acetate, works, bbl, lb.	.04-.05	.04-.05	.041-.05
Bicarbonate, bbl, cwt.	1.75-2.00	1.75-2.00	1.75-2.00
Bichromate, caaka, lb.	.061-.07	.061-.07	.061-.07
Bisulphate, bulk, ton.	15.00-16.00	15.00-16.00	15.00-16.00
Bisulphite, bbl, lb.	.031-.04	.031-.04	.031-.04
Chlorate, kegs, lb.	.061-.061	.061-.061	.061-.061
Chloride, tech., ton.	12.00-14.75	12.00-14.75	12.00-14.75
Cyanide, caas, dom., lb.	.14-.15	.14-.15	.161-.17
Fluoride, bbl, lb.	.071-.08	.071-.08	.071-.08
Hyposulphite, bbl, cwt.	2.40-2.50	2.40-2.50	2.40-2.50
Metaallite, bbl, cwt.	2.20-3.20	2.20-3.20	2.15-3.15
Nitrate, bags, cwt.	1.45-1.45	1.45-1.45	1.425-1.425
Nitrite, caaka, lb.	.061-.07	.061-.07	.07-.08
Phosphate, dibasic, bags, lb.	1.85-1.85	1.85-1.85	1.70-.024
Prussiate, yel. drums, lb.	.091-.10	.091-.10	.10-.11
Silicate (40" dr.) wks, cwt.	.80-.85	.80-.85	.80-.85
Sulphide, fused, 60-62%, dr., lb.	.021-.031	.021-.031	.021-.031
Sulphite, cyrs, bbl, lb.	.021-.021	.021-.021	.021-.021
Sulphur, crude at mine, bulk, ton	18.00-18.00	18.00-18.00	18.00-18.00
Chloride, dr., lb.	.03-.04	.03-.04	.031-.04
Dioxide, cyl, lb.	.07-.08	.07-.08	.07-.071
Flour, bag, cwt.	1.60-3.00	1.60-3.00	1.60-3.00
Tin Oxide, bbl, lb.	.48-.48	.44-.44	.58-.58
Crysalts, bbl, lb.	.35-.35	.35-.35	.411-.411
Zinc chloride, gran., bbl, lb.	.05-.06	.05-.06	.05-.06
Carbonate, bbl, lb.	.14-.15	.14-.15	.09-.11
Cyanide, dr., lb.	.33-.35	.33-.35	.36-.38
Dust, bbl, lb.	.061-.061	.061-.061	.089-.089
Zinc oxide, lead free, bags, lb.	.061-.061	.061-.061	.061-.061
5% lead sulphate, bags, lb.	.061-.061	.061-.061	.061-.061
Sulphate, bbl, cwt.	3.15-3.60	3.15-3.60	3.15-3.60

## OILS AND FATS

	Current Price	Last Month	Last Year
Castor oil, No. 3, bbl, lb.	\$0.091-\$0.10	\$0.091-\$0.10	\$0.101-\$0.11
Chinawood oil, bbl, lb.	.141-.141	.121-.121	.12-.12
Coconut oil, Ceylon, tanks, N. Y. lb.	.031-.031	.031-.031	.051-.051
Corn oil crude, tanks (f.o.b. mill), lb.	.08-.08	.071-.071	.08-.08
Cottonseed oil, crude (f.o.b. mill), tanks, lb.	.071-.071	.07-.07	.07-.07
Linseed oil, raw ear lots, bbl, lb.	.086-.086	.086-.086	.112-.112
Palm, caaka, lb.	.04-.04	.04-.04	.051-.051
Peanut oil, crude, tanks (mill), lb.	.081-.081	.071-.071	.08-.08
Rapeseed oil, refined, bbl, gal.	.75-.75	.75-.75	.96-.96
Soya bean, tank, lb.	.061-.061	.06-.06	.071-.071
Sulphur (olive foeta), bbl, lb.	.071-.071	.071-.071	.111-.111
Cod, Newfoundland, bbl, gal.	.38-.38	.50-.50	.52-.52
Menhaden, light pressed, bbl, lb.	.069-.069	.069-.069	.83-.83
Crude, tanks (f.o.b. factory), gal.	.30-.30	.27-.27	.40-.40
Grease, yellow, loas, lb.	.051-.051	.041-.041	.071-.071
Oleo stearine, lb.	.081-.081	.071-.071	.091-.091
Oleo oil, No. 1.	.091-.091	.09-.09	.121-.121
Red oil, distilled, d.p. bbl, lb.	.081-.081	.081-.081	.111-.111
Tallow extra, loas, lb.	.051-.051	.051-.051	.071-.071



# Chem. & Met.'s Weighted Price Indexes



## COAL-TAR PRODUCTS

	Current Price	Last Month	Last Year
Alpha-naphthol, crude bbl., lb.	\$0.52 - \$0.55	\$0.52 - \$0.55	\$0.52 - \$0.55
Alpha-naphthylamine, bbl., lb.	.32 - .34	.32 - .34	.32 - .34
Aniline oil, drums, extra, lb.	.15 - .16	.15 - .16	.15 - .16
Aniline salts, bbl., lb.	.22 - .24	.22 - .24	.22 - .24
Benzaldehyde, U.S.P., dr., lb.	.85 - .95	.85 - .95	.85 - .95
Benzidine base, bbl., lb.	.70 - .75	.70 - .75	.70 - .75
Benzoin acid, U.S.P., kgs., lb.	.54 - .56	.54 - .56	.54 - .56
Benzoyl chloride, tech., dr., lb.	.25 - .27	.25 - .27	.25 - .27
Benzol, 90%, tanks, works, gal.	.16 - .18	.16 - .18	.16 - .18
Beta-naphthol, tech., drums, lb.	.23 - .24	.23 - .24	.23 - .24
Cresol, U.S.P., dr., lb.	.10 - .11	.10 - .11	.10 - .11
Cresylic acid, dr., wks., gal.	.78 - .80	.78 - .80	.78 - .80
Diethylaniline, dr., lb.	.40 - .45	.40 - .45	.40 - .45
Dinitrophenol, bbl., lb.	.23 - .25	.23 - .25	.23 - .25
Dinitrotoluen, bbl., lb.	.15 - .16	.15 - .16	.15 - .16
Dip oil, 15%, dr., gal.	.23 - .25	.23 - .25	.23 - .25
Diphenylamine, bbl., lb.	.32 - .36	.32 - .36	.32 - .36
H-acid, bbl., lb.	.30 - .35	.30 - .35	.30 - .35
Naphthalene, flake, bbl., lb.	.06 - .07	.06 - .07	.06 - .07
Nitrobenzene, dr., lb.	.08 - .09	.08 - .09	.08 - .09
Para-nitraniline, bbl., lb.	.50 - .52	.50 - .52	.50 - .52
Phenol, U.S.P., drums, lb.	.14 - .15	.14 - .15	.14 - .15
Picric acid, bbl., lb.	.35 - .40	.35 - .40	.35 - .40
Pyridine, dr., gal.	1.55 - 1.60	1.55 - 1.60	1.55 - 1.60
Resorcinol, tech., kgs., lb.	.75 - .80	.75 - .80	.75 - .80
Salicylic acid, tech., bbl., lb.	.32 - .40	.32 - .40	.32 - .40
Solvent naphtha, w.w., tanks, gal.	.26 - .28	.26 - .28	.26 - .28
Tolidine, bbl., lb.	.88 - .90	.88 - .90	.88 - .90
Toluene, tanks, works, gal.	.26 - .28	.26 - .28	.26 - .28
Xylene, com, tanks, gal.	.26 - .28	.26 - .28	.26 - .28

## MISCELLANEOUS

	Current Price	Last Month	Last Year
Barytes, grd., white, bbl., ton.	\$22.00 - \$25.00	\$22.00 - \$25.00	\$22.00 - \$25.00
Casein, tech., bbl., lb.	.09 - .11	.08 - .10	.13 - .14
China clay, dom., f.o.b. mine, ton.	8.00 - 20.00	8.00 - 20.00	8.00 - 20.00
Dry colors			
Carbon gas, black (wks.), lb.	.02 - .30	.02 - .30	.04 - .30
Prussian blue, bbl., lb.	.36 - .37	.36 - .37	.37 - .38
Ultramarine blue, bbl., lb.	.10 - .26	.10 - .26	.10 - .26
Chromes green, bbl., lb.	.21 - .30	.21 - .30	.26 - .27
Carmine red, tins, lb.	4.00 - 4.40	4.00 - 4.40	4.00 - 4.40
Para toner, lb.	.75 - .80	.75 - .80	.75 - .80
Vermilion, English, bbl., lb.	1.55 - 1.60	1.55 - 1.60	1.75 - 1.80
Chrome yellow, C. P., bbl., lb.	.14 - .15	.14 - .15	.13 - .14
Feldspar, No. 1 (f.o.b. N.C.), ton.	6.50 - 7.50	6.50 - 7.50	6.50 - 7.50
Graphite, Ceylon, lump, bbl., lb.	.06 - .06	.06 - .06	.06 - .06
Gum copal Congo, bags, lb.	.06 - .30	.06 - .30	.08 - .30
Manila, bags, lb.	.07 - .14	.07 - .14	.09 - .14
Damar, Batavia, cases, lb.	.16 - .24	.16 - .24	.15 - .24
Kauri cases, lb.	.17 - .60	.17 - .60	.19 - .25
Kieselguhr (f.o.b. N. Y.), ton.	50.00 - 55.00	50.00 - 55.00	50.00 - 55.00
Magnesite, calc, ton.	50.00 - .	50.00 - .	50.00 - .
Pumice stone, lump, bbl., lb.	.05 - .07	.05 - .08	.05 - .07
Imported, cases, lb.	.03 - .04	.03 - .04	.03 - .04
Rosin, H., bbl.	5.95 - .	6.10 - .	8.85 - .
Turpentine, gal.	.28 - .	.29 - .	.36 - .
Shellac, orange, fine, bags, lb.	.20 - .	.20 - .	.23 - .
Bleached, bonedry, bags, lb.	.19 - .	.18 - .	.17 - .
T. N. Bags, lb.	.11 - .	.11 - .	.12 - .
Soapstone (f.o.b. Vt.), bags, ton.	10.00 - 12.00	10.00 - 12.00	10.00 - 12.00
Talc, 200 mesh (f.o.b. Vt.), ton.	8.00 - 8.50	8.00 - 8.50	8.00 - 8.50
300 mesh (f.o.b. Ga.), ton.	7.50 - 10.00	7.50 - 10.00	7.50 - 11.00
225 mesh (f.o.b. N. Y.), ton.	13.75 - .	13.75 - .	13.75 - .

## INDUSTRIAL NOTES

AMERICAN CYANAMID Co., New York, has disposed of its interest in John Campbell & Co., Inc., to a group of Campbell employees.

WORTHINGTON PUMP AND MACHINERY CORP., Harrison, N. J., has transferred William J. Daly from Detroit to Philadelphia, where he succeeds C. H. Shaw, deceased.

THE CANADIAN RESEARCH INSTITUTE, 705 Spadina Ave., Toronto, Canada, has recently been established to furnish aid to companies in developing new products.

SIMPLEX VALVE & METER Co., Philadelphia, is now represented in New England by C. W.

Faldwin, 230 Congress St., Boston, and in Kansas City, Mo., by J. J. Heinrichson, 3689 Jefferson St.

THE CALCO CHEMICAL CO., INC., Bound Brook, N. J., announces that John H. Grady has joined the Boston office, George Lommel, the Bound Brook office, and Robert P. Wood, the Providence office.

A. K. HAMILTON, New York, sales representative for the Pennsylvania Alcohol Corp. and the Franco American Chemical Works has moved his office to 745 Fifth Ave.

STRUTHER-WELLS TITUSVILLE CORP., War-

ren, Pa., has appointed Hymen Ledeen, 747 Warehouse St., Los Angeles, as sales representative in lower California, Arizona, New Mexico and Western Texas.

READ MACHINERY CO., INC., York, Pa., has advanced A. K. Brennan to the factory engineering division. E. C. B. Fletcher succeeds Mr. Brennan as sales engineer in the New York territory.

PLASTOID PRODUCTS CO., INC., has established a plant at 518 City Park Ave., New Orleans, and are making plastoid products under license of Plastoid Products Co. of Detroit.

# New CONSTRUCTION

## PROPOSED WORK

**Cinder Block Plant**—Wilson Welder & Metals Co., Sparrow Point, Md., subsidiary of Air Reduction Sales Co., 60 East 42nd St., New York, N. Y., will soon award the contract for the construction of a 1 story, 100x400 ft. cinder block plant. Estimated cost \$100,000.

**Chemical Laboratory**—Cole Chemical Co., Inc., B. L. Cole, Pres., 3721 Laclede Ave., St. Louis, Mo., is having plans prepared by Hugo K. Graf, Archt., 2825 Olive St., St. Louis, for a 2 story, part basement, 30x100 ft. with 55x120 ft. ell, chemical laboratory. Estimated cost \$75,000.

**Factory**—Fibre Soaps, Ltd., c/o Clive J. MacLeod, K. C., 303 Lombard Bldg., Winnipeg, Man., Can., is having plans prepared for the construction of a factory for the manufacture of cleaning and cleansing supplies, etc. New equipment will be installed. Estimated cost \$40,000.

**Factory**—Skid Chek Caneds, Ltd., c/o George F. Foss, 4326 Colbourne St., Montreal, Que., Can., is having plans prepared for the construction of a factory for the manufacture of chemical compounds and products. Estimated cost \$49,000.

**Glass Factory**—Horwood & White, Archts., 229 Yonge St., Toronto, Ont., Can., will soon award the contract for the construction of a 2 story addition to glass factory for Pilkington Bros., Ltd., 19 Mercer St., Toronto. Estimated cost \$75,000.

**Laboratory**—Chemical Pigments Co., 6401 St. Helena Ave., Baltimore, Md., is having plans prepared for the construction of a 1 story, 40x100 ft. laboratory and boiler house. Estimated cost \$75,000.

**Oil Refinery**—Argo Oil Co., Ltd., 5 Industrial St., Leaside, Ont., Can., plans to construct an oil refinery and is now negotiating for a site. Estimated cost \$500,000.

**Oil Refinery**—Les Huilles Union Ltd., c/o Henri Bouchard, K. C., 323 Boulevard Charest, Quebec City, Que., plans to construct an oil refinery. Estimated cost \$40,000.

**Oil Refinery**—McCall Frontenac Oil Co., Ltd., J. M. Pritchard, Vice Pres., Notre Dame East, Montreal, Que., Can., is having plans prepared for the construction of an oil refinery at Regina, Sask., Can. Estimated cost \$500,000.

**Oil Refinery**—Shell Petroleum Corp., 1221 Locust St., St. Louis, Mo., plans to reconstruct its oil compound house at its refinery at Roxana, Ill., which was recently destroyed by fire.

**Paint Factory**—Benjamin Franklin Paint & Varnish Co., 4820 Langdon St., Philadelphia, Pa., subsidiary of Sears, Roebuck & Co., Chicago, Ill., plans to construct an addition to its factory.

**Pulp Mill**—Prince Rupert Lumber, Pulp & Paper Mills, Ltd., Prince Rupert, B. C., Can., is having plans prepared for the construction of a pulp mill. Estimated cost \$1,000,000.

**Petroleum Plant**—Puregas, Ltd., Port Hope, Ont., Can., is having plans prepared for the construction of a plant for the manufacture of liquified petroleum. Estimated cost \$40,000.

## Where Plants Are Being Built in Process Industries

	Current Projects		Cumulative 1938	
	Proposed Work	Contracts	Proposed Work	Contracts
New England.....			\$240,000	\$929,000
Middle Atlantic.....	\$215,000	\$535,000	6,184,000	3,808,000
South.....	100,000	1,885,000	20,570,000	9,252,000
Middle West.....			13,077,000	4,082,000
West of Mississippi.....	115,000	130,000	17,350,000	4,975,000
Far West.....			1,180,000	2,482,000
Canada.....	2,284,000	607,000	19,194,000	3,860,000
Total.....	\$2,714,000	\$3,137,000	\$77,795,000	\$29,358,000

**Warehouse**—Amherst Distillers, W. F. Knight, Gen. Mgr., Amherstburg, Ont., Can., contemplate the construction of a rack warehouse and tank house and will install equipment for manufacturing grain whiskies and industrial alcohol. Estimated cost \$40,000.

**Warehouse**—Frankfort Distilleries, Columbia Bldg., Louisville, Ky., are having plans prepared for the construction of a rack warehouse. Estimated cost \$100,000.

## CONTRACTS AWARDED

**Asphalt Plant**—Barber Asphalt Co., Barber, N. J., has awarded the contract for an addition to its plant to Carlson Co., 89 Walnut St., Montclair, N. J. Estimated cost \$165,000.

**Cement Plant**—Lehigh Portland Cement Co., Alsen, N. Y., will rehabilitate its plant here and also install new equipment. Work will be done by its own forces. Estimated cost will exceed \$100,000.

**Factory**—Bohn Aluminum & Brass Co., 1400 Lafayette Bldg., Detroit, Mich., has awarded the contract for the construction of a 1 story furnace room to the Kriehoff Co., 6661 French Rd., Detroit, Mich. Estimated cost \$40,000.

**Factory**—Cleveland Cleaner & Paste Co., F. V. Gilbert, Pres., 7275 Neville Ave., Cleveland, O., has awarded the contract for a 1 story, 40x75x120 ft. addition to its factory, to Paramount Construction Co., 750 Prospect Ave., Cleveland. Estimated cost \$40,000.

**Factory**—Eastman Kodak Co., Kodak Park, Rochester, N. Y., has awarded the contract for an addition to its distilling plant to Ridge Construction Corp., Kodak Park. Estimated cost \$50,000.

**Kiln Building**—Garden City Pottery Co., 560 North 6th St., San Jose, Calif., will construct a kiln building and warehouse. Contract for steel frame has been awarded to Herrick Iron Works, 1729 Campbell St., Oakland, at \$26,324. Rest of work will be done by owner. Total estimated cost \$40,000.

**Laboratory**—Goodrich Tire & Rubber Co., Akron, O., has awarded the contract for the construction of a 3 story, 40x50 ft. addition to its plant to be used as an experimental laboratory to Carmichael Construction Co., Akron. Estimated cost \$50,000.

**Distillation Unit**—Ashland Oil & Refining Co., Inc., Ashland, Ky., has awarded the contract for constructing 7,000 bbl. per day combination atmo-

spheric and vacuum petroleum distillation unit to Lummus Co., Graybar Bldg., New York, N. Y.; 30,000,000 BTU heater to afford increased capacity to Dubbs cracking unit to Alcorn Combustion Co., Bellevue Court Bldg., Philadelphia, Pa.; 7x55 ft. fractionating column to A. O. Smith Corp., 3533 North 27th St., Milwaukee, Wis.; hot oil pump for this installation to National Transit Co., Oil City, Pa. The installation of the equipment referred to above will complete 1938 program of the Company for modernization and expansion at their refinery at Catlettsburg, Ky. Estimated cost between \$400,000 and \$500,000.

**Oil Refinery**—Inland Empire Refineries, c/o E. Kaye, Davenport Hotel, Spokane, Wash., have awarded the contract for the construction of an oil refinery to have a daily capacity of 2,200 bbl. to Winkler Koch Engineering Co., 335 West Lewis St., Wichita, Kan. Estimated cost \$522,000.

**Oil Refinery**—Sinclair Oil Co., Wells-ville, N. Y., plans to rebuild its oil refinery recently destroyed by fire. Work will be done by separate contracts. Estimated cost will exceed \$100,000.

**Paper Board Plant**—Carolina Paper Board Co., Charlotte, N. C., has awarded the contract for the construction of a plant to E. L. Bass & Bros. Construction Co., 708 Bainbridge Bldg., Richmond, Va. Estimated cost \$35,000.

**Roofing Factory**—Dixie Asphalt Co., c/o R. N. Hitch, Mayor, Savannah, Ga., has awarded the contract for a 1, 2 and 3 story roofing factory at Savannah, to Artley Co., 504 East Bay St., Savannah. Estimated cost \$350,000.

**Wall Board Plant**—National Gypsum Co., Delaware Ave., Buffalo, N. Y., has awarded the contract for constructing a wall board plant, dock, etc., at Savannah, Ga., to George A. Fuller Co., 597 Madison Ave., New York, N. Y. Estimated cost between \$800,000 and \$1,000,000.

**Warehouse**—Hazel Atlas Glass Co., 89th and G Sts., Oakland, Calif., has awarded the contract for a warehouse and boiler plant to Larsen & Larsen, 629 Bryant St., San Francisco. Estimated cost \$45,000.

**Warehouse**—Hunter Baltimore Rye Distillery, Inc., 405 West Redwood St., Baltimore, Md., has awarded the contract for the construction of a 6 story, 90x150 ft. warehouse to G. Walter Tovall, Eutaw and McCulloch Sts., Baltimore. Estimated cost \$120,000.



## LARGE FACTORY CONSUMPTION OF VEGETABLE OILS IN FIRST HALF OF YEAR

THE Bureau of the Census, under date of July 29, released figures showing factory production and consumption for oils and fats for the second quarter of this year. Taking these figures in conjunction with those previously published for operations in the first quarter of the year, it is found that factory consumption of both crude and refined vegetable oils has run counter to the trend of general business. Production of cottonseed oil—which holds first place from a tonnage standpoint—naturally varies according to the size of the cotton crop and the consequent supply of cottonseed. Last year the cotton crop was large and the output of oil was correspondingly large. Fears of an over-supply and of a greatly enlarged carry-over into the next crop year, however, have been proved unfounded and a new record for cotton oil consumption has been established for the oil year which ended July 31. That this record was not made at the expense of other vegetable oils is shown by the fact that factory consumption of all vegetable oils in the first half of this year was larger than that for the corresponding period of any preceding year.

Factory consumption of vegetable oils for the last 10 years was as follows, the figures for each year referring to the Jan.-June period:

### Factory Consumption of Vegetable Oils

First six months of year		
	Crude 1,000 lb.	Refined 1,000 lb.
1938 —	1,933,232	1,148,556
1937 —	1,741,615	944,429
1936 —	1,559,389	838,203
1935 —	1,244,340	824,060
1934 —	1,482,544	699,295
1933 —	1,363,943	646,726
1932 —	1,448,778	602,157
1931 —	1,406,200	704,657
1930 —	1,587,758	780,655
1929 —	1,675,621	778,498

The above total for refined oil will fall somewhat short of actual factory consumption because no figures for refined are included in the case of sesame and miscellaneous oils. Consumption of crude oils includes the amounts used for conversion into refined oils.

In addition to the large increase in consumption of cottonseed in the first half of this year was a noticeable rise in the disappearance of soybean oil, a large part of which was refined and sold in the edible trades. Factory consumption of crude soybean oil for the six month period was reported at 115,813,000 lb. which exceeds that for any year since 1920. In 1920 and in the years immediately preceding soybean oil was duty

free and importations ran to large volume. However, during the era of heavy importing of soybean oil, relatively small amounts were refined whereas in the first half of this year, consumption of refined soybean oil was 91,955,000 lb.

In viewing the status of other vegetable oils, with the exception of drying oils, it is found that edible uses have offered the principle outlets. Coconut oil apparently was well divided between edible and industrial uses as factory consumption of the crude product in Jan.-June amounted to 272,906,000 lb. while factory consumption of refined reached 136,376,000 lb. Incidentally, coconut oil produced in this country played a more important part in the 1938 business than had been the case since 1934 and the home product of 145,133,000 lb. represented a gain of more than 12 per cent over that for the six-month period of 1937.

From 1935 to date, peanut oil has held a more prominent position and while consumption of crude this year ran ahead of the comparable 1937 total, the movement of refined was not in keeping. In previous years data for palm oil was confined to crude but the growing use of this oil for edible purposes is seen in the current reports which contain statistics for refined oil. In 1937, edible

use of palm oil was divided: 123,677,000 lb. for shortening; 1,063,000 lb. for oleomargarine; and 944,000 lb. for other edible uses. For the first half of this year, consumption of crude palm oil was 132,618,000 lb. and consumption of refined was 50,773,000 lb.

Consumption of drying oils for the 1938 period fell materially below the levels reached in the first half of 1937. The combined factory consumption of linseed, tung, and perilla oils was more than 32 per cent below the 1937 total. This reflected the slower rate of operations which prevailed in the paint and varnish, linoleum and oilcloth, and printing ink trades, which are the largest consuming outlets for these oils.

Factory and warehouse stocks of vegetable oils on June 30, 1938, were larger than they were on the corresponding date last year. The total for all vegetable oils—crude and refined—was approximately 1,205,505,000 lb. on June 30, 1937, and had risen to 1,449,572,000 lb. on Dec. 31 and declined to 1,399,981,000 lb. on June 30, 1938. Cottonseed oil had much to do with the changing stock position. It is worthy of note, however, that despite the large gain in production, stocks of crude and refined cottonseed oil on June 30, 1938, were about 612,513,000 lb. only 73,806,000 lb. above the June 1937 figure and 35,707,000 lb. lower than the stocks on hand at the beginning of this year. Contrary to what might have been expected, stocks of tung oil on June 30 were larger than at the opening of the year and also larger than those held on June 30, 1937.

### Factory Production, Consumption and Stocks of Vegetable Oils

Vegetable Oils	Factory operations for the quarter ending June 30, 1938		Factory and Warehouse stocks June 30, 1938
	Production lb.	Consumption lb.	
Cottonseed, crude.....	233,034,011	351,968,767	46,761,441
Cottonseed, refined.....	318,998,904	328,176,827	565,751,449
Peanut, virgin and crude.....	31,444,029	27,064,277	6,179,818
Peanut, refined.....	26,015,477	15,077,396	27,752,235
Coconut or copra, crude.....	70,477,228	150,793,411	194,144,730
Coconut or copra, refined.....	79,790,263	72,942,599	13,492,586
Corn, crude.....	30,453,087	31,495,360	8,782,573
Corn, refined.....	28,408,890	16,012,334	8,832,769
Soybean, crude.....	63,462,531	55,907,423	52,123,096
Soybean, refined.....	49,025,761	42,319,859	24,435,164
Olive, edible.....	.....	929,819	4,670,240
Olive, inedible.....	.....	914,188	1,025,267
Sulphur oil or olive foots.....	.....	3,760,386	7,047,978
Palm-kernel, crude.....	.....	9,718,436	10,296,298
Palm-kernel, refined.....	4,950,956	5,866,484	637,430
Palm, crude.....	.....	62,775,491	147,847,070
Palm, refined.....	25,164,262	23,331,497	12,265,587
Babassu, crude.....	8,298,530	7,370,043	6,137,205
Babassu, refined.....	4,660,557	4,095,536	638,204
Rapeseed.....	.....	1,076,556	2,997,202
Linseed.....	77,513,277	81,891,716	145,909,036
Chinese wood or tung.....	.....	22,022,774	54,705,883
Perilla.....	.....	8,215,869	20,419,116
Castor.....	9,972,980	6,170,413	18,230,517
Sesame.....	.....	1,897,712	1,359,930
All other.....	2,832,405	8,115,403	17,538,343